

REMEDIAL INVESTIGATION/FEASIBILITY STUDY

STAGE 2

EPA Region 5 Records Ctr.



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AIR FORCE PLANT 85
COLUMBUS, OHIO

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
Environmental Remediation Division
14062 Denver West Parkway
Building 52, Suite 250
Golden, Colorado 80401

SEPTEMBER 1990

VOLUME I
MAIN REPORT
FINAL

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PREPARED FOR:

HEADQUARTERS AERONAUTICAL SYSTEMS DIVISION
FACILITIES MANAGEMENT DIVISION (ASD/PMDA)
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45435-6503

HEADQUARTERS AIR FORCE SYSTEMS COMMAND
COMMAND BIOENVIRONMENTAL ENGINEER
ANDREWS AIR FORCE BASE, DISTRICT OF COLUMBIA 20334-5000

UNITED STATES AIR FORCE
HUMAN SYSTEMS DIVISION (HSD/YAQI)
BROOKS AIR FORCE BASE, TEXAS 78235-5501

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HUMAN SYSTEMS DIVISION (HSD/YAQI)
BROOKS AIR FORCE BASE, TEXAS 78235-5501

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PREFACE

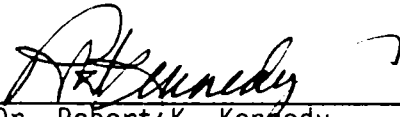
This report addresses the results of the Installation Restoration Program (IRP) Remedial Investigation/Feasibility Study (RI/FS), Stage 2 investigation for Air Force Plant 85 in Columbus, Ohio. Five sites, plus a Plant-wide groundwater monitoring system, were studied to determine the magnitude of contamination, its extent and potential for migration, to identify any significant public health and environmental hazards, and to identify remedial alternatives based on state and federal standards.

The Stage 2 investigation was conducted by Science Applications International Corporation (SAIC) under Air Force Contract Number F33615-85-D-4507, Delivery Order No. 21. This document presents the results of the investigations which began in September 1988 and were completed in December 1988.

Captain Charles W. Attebery, Human Systems Division/YAQL, was the Technical Program Manager (TPM) for this project. Program Manager was Dr. Robert K. Kennedy and Deputy Program Manager was Dr. R. Wayne Nelson. Mr. John R. Dwyer acted as Project Manager during the field investigation and, subsequently, as the Data Manager. The field team consisted of Messrs. Luke Darragh, Environmental Scientist, and Pete Ferron, Environmental Technician. Dr. Norman Richenbach conducted the ecology study. Ms. Rotha Randall, Environmental Scientist, and Ms. Eve Huggins, Environmental Geologist, were the Project Managers and principal authors, while Messrs. Luke Darragh and Mark Kadnuck, Chemical Engineer, assisted with the preparation of the report. Ms. Rotha Randall also edited and produced the report. Ms. Wendy Morris, Ms. Melanie Reker, Ms. Leslie Rodriguez, and Ms. Jill Roghair provided staff support. Mr. Ed Weiland produced graphics for this report. Dr. Tom Naymick from Battelle-Columbus Division Environmental Department assisted in hydrologic data analysis. Appendix K provides biographies of the SAIC team members.

The drilling subcontractor was Mason-de Verteuil, which also analyzed selected soil samples. Survey work was performed by John E. Foster Associates for RI/FS, Stage 2. Brown and Caldwell Laboratories provided laboratory analytical chemistry with Ms. Linda Brack acting as their Project Manager.

APPROVED:



Dr. Robert K. Kennedy
Program Manager

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EXECUTIVE SUMMARY

INTRODUCTION

The U.S. Air Force (USAF) Installation Restoration Program (IRP) is designed to identify, confirm/quantify, and remediate problems caused by past management of hazardous wastes at Air Force facilities. It is the basis for assessment and response actions on USAF installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA). The objectives of the Air Force IRP are to assess past hazardous waste disposal and spill sites on Air Force installations, and to develop remedial actions consistent with the National Contingency Plan (NCP) for those sites which pose a threat to human health and welfare, or to the environment.

Prior to 1988, the basic USAF IRP was a program comprised of four phases. Now, this phased approach has been superseded by one more closely following the Remediation Investigation/Feasibility Study (RI/FS) format used by the U.S. Environmental Protection Agency (EPA). The new IRP RI/FS format combines the old Phase II, Confirmation/Quantification Study, and the Phase IVa, Remedial Action Planning, to efficiently arrive at appropriate remedial actions in a timely manner.

A remedial investigation is conducted in stages to collect information on the type and extent of contamination in the environment through field sampling. The results are evaluated in terms of public health and environmental criteria. A feasibility study, in which remedial alternatives are identified and ultimately recommended for selection, is conducted somewhat in parallel with the remedial investigation so that field data needed to select a remedy are collected during the field investigation.

The RI/FS is intended systematically to:

- o Identify and prioritize contamination sources with respect to hazard
- o Determine the nature and extent of contamination, or conclude that no significant adverse impact exists

- o Determine the pathways and risks of the identified contamination to various human and environmental receptors
- o Plan and conduct field activities that will support the selection and eventual design of appropriate remedial actions
- o Develop appropriate remedial alternatives.

Science Applications International Corporation (SAIC), Environmental Remediation Division, has prepared the following RI/FS under contract with the USAF Human Systems Division (HSD/YAQI). This RI/FS report summarizes the results of research on the Air Force (AF) Plant 85, Columbus, Ohio, under the IRP, incorporating other appropriate research. The overall intent of this study is to evaluate the existing data to define appropriate remedial actions at the site.

INSTALLATION DESCRIPTION AND SETTING

AF Plant 85 is located in Franklin County about 6 miles northeast of downtown Columbus, Ohio, just south of the Port Columbus International Airport (Figure ES-1). The Plant occupies approximately 300 acres.

Completed in 1941, AF Plant 85 produced naval aircraft during World War II under contract with the Curtiss-Wright Corporation. Production declined after the war and Curtiss-Wright discontinued operations in 1950. In late 1950, the U.S. Navy took over title to the Plant, which became the Naval Industrial Reserve Aircraft Plant (NIRAP) Columbus. At that time, North American Aviation (now Rockwell International) took over Plant operations. Numerous kinds of naval aircraft and missile systems were produced and tested over the next several years. In 1982, NIRAP Columbus was transferred to the U.S. Air Force from the Navy and designated AF Plant 85; Rockwell International was awarded the contract for the production of the B-1B bomber aircraft. AF Plant 85 is now operated by McDonald-Douglas for the production of aircraft parts.

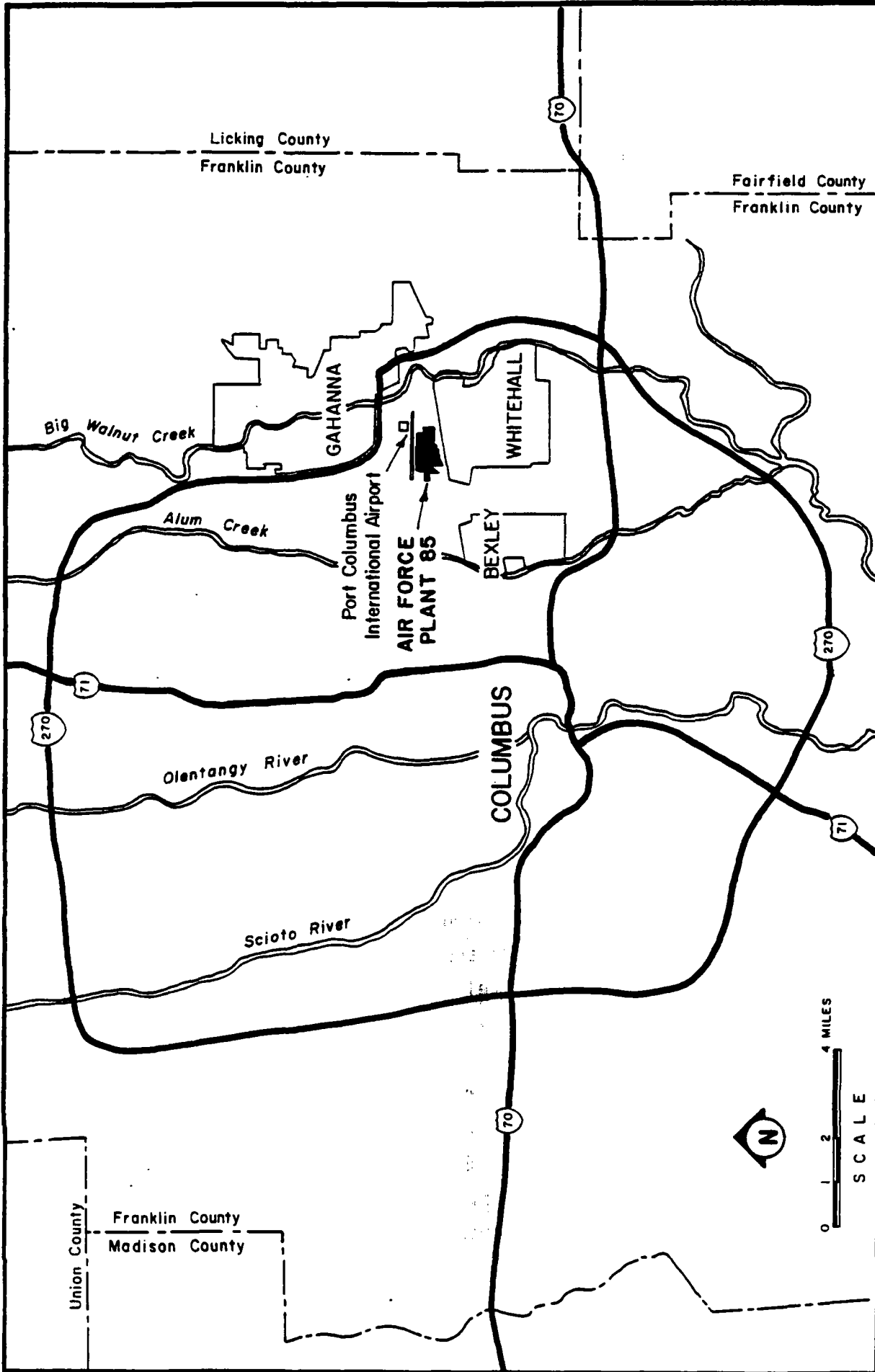


Figure ES-1. Location Map of Air Force Plant 85, Columbus, Ohio.

The ground surface at the facility is relatively flat, with elevations varying from 800 to 815 feet above mean sea level (msl). The only significant relief near the facility occurs in areas adjacent to streams, glacial moraines, or resistant bedrock.

The geologic setting in the central Ohio area consists of Mississippian and Devonian sedimentary rocks overlain by glacial deposits, alluvia, and soils from the Illinoian and Wisconsin Stages. The geology of the AF Plant 85 area is affected by both preglacial erosion of the bedrock and glacial features. Deep beneath the Plant, a major tributary of a preglacial river is in part filled with glacial outwash from the Illinoian Stage. Glacial till and outwash from the Wisconsin Stage overlie the Illinoian outwash. The Mississippian Ohio-Olentangy Shale is the underlying bedrock at AF Plant 85.

Groundwater beneath AF Plant 85 is present in two general aquifer systems: Devonian limestone aquifers and glacial outwash aquifers. The lower Devonian rocks are major sources of groundwater supply in western Franklin County (about 5 miles west of the Plant). The glacial deposits in the central portion of Franklin County yield groundwater, with the greatest yields obtained from the outwash. The southwestern portion of AF Plant 85 is underlain by a sand and gravel outwash aquifer system. Most of the remaining portion of the Plant area is underlain by lenses of sand and gravel interbedded in clayey till which yield groundwater at various rates, depending on the thickness of the sand and gravel lenses. Numerous potable water supply wells have been drilled near and on the AF Plant 85 property. These wells were developed in glacial outwash. An estimated 50 to 100 private wells may still be in use within this radius.

The principal river in Franklin County is the Scioto River which flows southward through downtown Columbus toward the Ohio River. AF Plant 85 is located within the drainage basin of Big Walnut Creek, a tributary of the Scioto River. Surface water runoff from the Plant discharges into two creeks: Turkey Run, located in the western portion of the site, and Mason's Run, located in the central Plant area. Both creeks enter the Plant boundary from the Port of Columbus International Airport to the north of AF Plant 85 and flow

south. These streams join Big Walnut Creek about 5 miles south of the site. Flow within these creeks is generally low except during periods of precipitation. Due to the large proportion of paved area and relatively impermeable surface soil, runoff is highly dependent on storm events.

✓ Surface water is the primary source of municipal water supplies in Franklin County. The Morse Road Treatment Plant, which provides water to AF Plant 85, is supplied by Hoover Reservoir, which also serves the northern and eastern portions of the city of Columbus. Hoover Reservoir, located 8 miles north of AF Plant 85 on Big Walnut Creek, is used for both water supply and flood control. No known surface water supplies are present within 3 miles downstream of AF Plant 85.

SITE INVESTIGATIONS

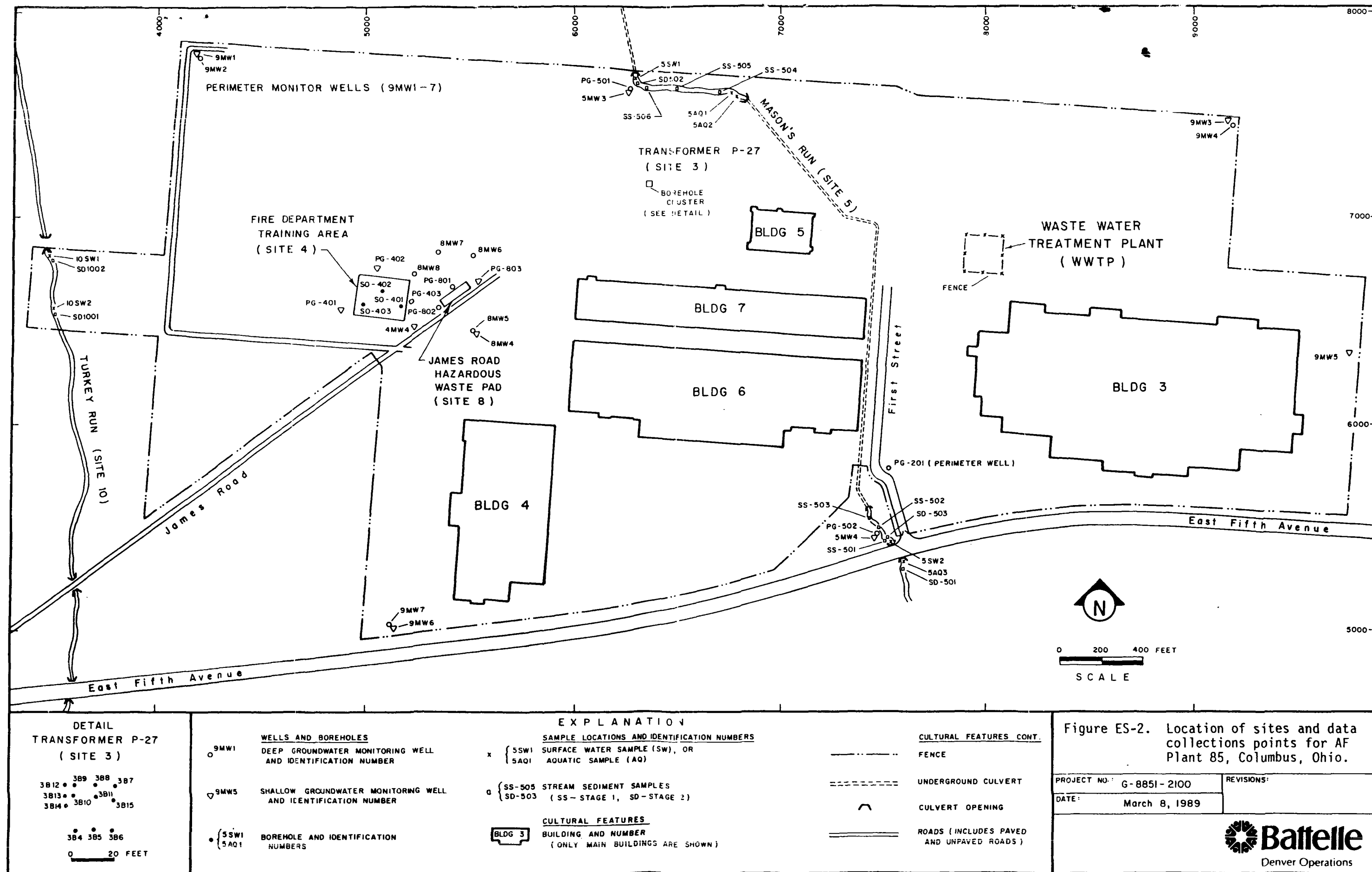
Figure ES-2 presents the locations of the investigated sites at AF Plant 85. Sites were selected from the Phase I investigation performed by CH2M HILL (1984), the Phase II, Stage 1 investigation performed by PEI and Battelle-Columbus (1988), and the Stage 2 Pre-survey performed by SAIC (formally Battelle Denver Operations) and HSD (1988).

Various waste-handling operations have occurred at AF Plant 85 since 1941. Specific information of waste disposal and storage practices at each site is provided in the following subsections.

PCB Spill Site (Site 3)

In January 1983, several gallons of transformer oil containing PCBs were spilled at this site. The spill occurred adjacent to Electric Substation 23. The site was excavated twice by Plant personnel. However, additional testing was required to determine the adequacy of these cleanup attempts.

Phase II, Stage 1 investigations consisted of soil sampling. Concentrations of PCBs were found which exceeded the action level of 50 ppm set by



40 CFR 761, Toxic Substance Control Act (TSCA). Stage 2 investigations were aimed at defining the areal and vertical extent of the PCB contamination.

Fire Department Training Area (Site 4)

Fire department training activities were conducted at AF Plant 85 (Site 4) from 1941 through 1977. Until 1970, at least one training exercise was conducted per month, after which their frequency slowly decreased to zero by 1977. As many as four fires were extinguished per session, with each session consuming approximately 900 gallons of fuel (waste magnesium chips, waste oils, and contaminated aircraft fuel). When this training area was deactivated in 1977, the soil was excavated to a depth of about 30 inches and the area was backfilled with clean dirt.

Phase II, Stage 1 investigations included soil and groundwater sampling. Elevated concentrations of purgeable organics were found in soils, but not in any of the groundwater samples. Determination of the extent of contamination in the soil required confirmation. This was done in the RI/FS, Stage 2.

Mason's Run Oil/Fuel Spill Site (Site 5)

Much of Mason's Run is channeled within an underground concrete culvert throughout the Plant. The stream enters the Plant area along the northern boundary (after passage through Port Columbus International Airport property) and exits the Plant in an open ditch near the Plant entrance gate located at the intersection of First Street and Fifth Avenue. This stream has received miscellaneous oil and fuel and coal-pile leachate from storm drains at various times since 1941. Approximately 15 years ago, an oil skimmer system, including a floating boom and a concrete weir, were installed at the south end of Mason's Run where it leaves the Plant property at East Fifth Avenue.

The Phase II, Stage 1 investigations consisted of soil, sediment, surface water, and groundwater sampling. The higher concentrations of chemicals found during Stage 1 sampling of the downstream stations, as compared to the upstream stations, initiated further investigation in Stage 2.

James Road Hazardous Waste Storage Pad (Site 8)

This site was used to store drums of hazardous wastes from 1941 until 1989. These wastes included 1,1,1-trichloroethane (1,1,1-TCA), acetone, mixtures of other solvents, and phenolic paint strippers. Several spills have been reported to have occurred on the ground adjacent to the concrete pad currently in place at this site. The James Road Hazardous Waste Storage Pad is no longer in use; the Air Force and Rockwell International (the previous Plant operator) are presently pursuing formal closure of this RCRA-permitted storage pad.

Phase II, Stage 1 investigations included soil and groundwater sampling. Purgeable organics were identified in soil samples and elevated levels of total halogenated compounds were detected in one groundwater sample. The identification of the compounds found in groundwater was a target of the RI/FS, Stage 2 investigations, as well as determination of any migration of the compounds in groundwater.

Turkey Run (Site 10)

Approximately 375 feet of Turkey Run crosses AF Plant 85 on the westernmost segment of land after passage through the Port of Columbus International Airport. This site was established during RI/FS, Stage 2 to monitor sediment and surface water quality at both the upstream and downstream boundaries of the site.

Perimeter Monitoring Wells

Perimeter monitoring wells were installed to measure groundwater quality to determine the effects of Plant activities on groundwater. For sampling purposes, the perimeter monitoring wells were given the field designations of 9MW1 through 9MW7. This site was established during RI/FS, Stage 2 to allow for monitoring the quality of the groundwater as it flows beneath the Plant's boundary, under the facility, and as it exits the property. Wells were placed

along the perimeter of the Plant. Also included in the perimeter monitoring system was Phase II, Stage 1 monitoring well PG201.

INVESTIGATIVE METHODOLOGIES

The remedial investigation for the RI/FS, Stage 2, was based on the findings and recommendations from the Phase II, Stage 1 investigation at AF Plant 85, Columbus, Ohio. The methodologies used to obtain data were selected on a site-by-site basis to provide the most useful information possible (Table ES-1) and were performed in accordance with Air Force guidance. Field work was conducted between 19 September and 16 December 1988. Procedures for obtaining field data are presented in Section 3.0.

Field duplicates and blanks (trip, equipment, and ambient condition) were prepared as quality control samples for water. Replicate samples were prepared to fulfill quality control requirements for soil samples.

RESULTS OF RI/FS, STAGE 2 INVESTIGATIONS

The brief discussion of results from the Stage 2 investigation and a risk assessment summary are presented below on a site-by-site basis.

Discussion of Results for PCB Spill Site (Site 3)

Site 3 is the location of a PCB spill which occurred in 1983 near Electric Substation 23, Transformer P-27, located in the north central part of AF Plant 85 (Figure ES-2).

Nine soil samples were collected during the Stage 1 investigation and 29 (including 3 duplicates), during the Stage 2 investigations. The samples were analyzed for the presence of PCBs only. Aroclor 1260 was the only PCB detected. The borehole locations and PCB concentrations at appropriate depth are illustrated in Figure ES-3.

**Table ES-1. Field Activities and Samples
by Site, AF Plant 85, Columbus, Ohio**

	Site 3	Site 4	Site 5	Site 8	Site 10	Perimeter Wells
<u>Soils:</u>						
Hand-augered # of Boreholes # of Samples	8 1-2/hole			2-3/hole		
Auger-drilled # of Boreholes	3	1	2	5		7
# of Soil Samples	4/hole	3				
Converted to Monitoring Well		1	2	5		7
Engineering Parameters						
Permeability		1		2		4
Grain-size Distribution		1	3	6	2	9
Moisture		1	3	6	2	9
Sediment			3		2	
<u>Water:</u>						
Groundwater Sampling						
New Wells		1	2	5		7
Existing Wells		3	2	3		1
Surface Water			2		2	
Slug Test		4	2	8		6
Ecology Study			1			

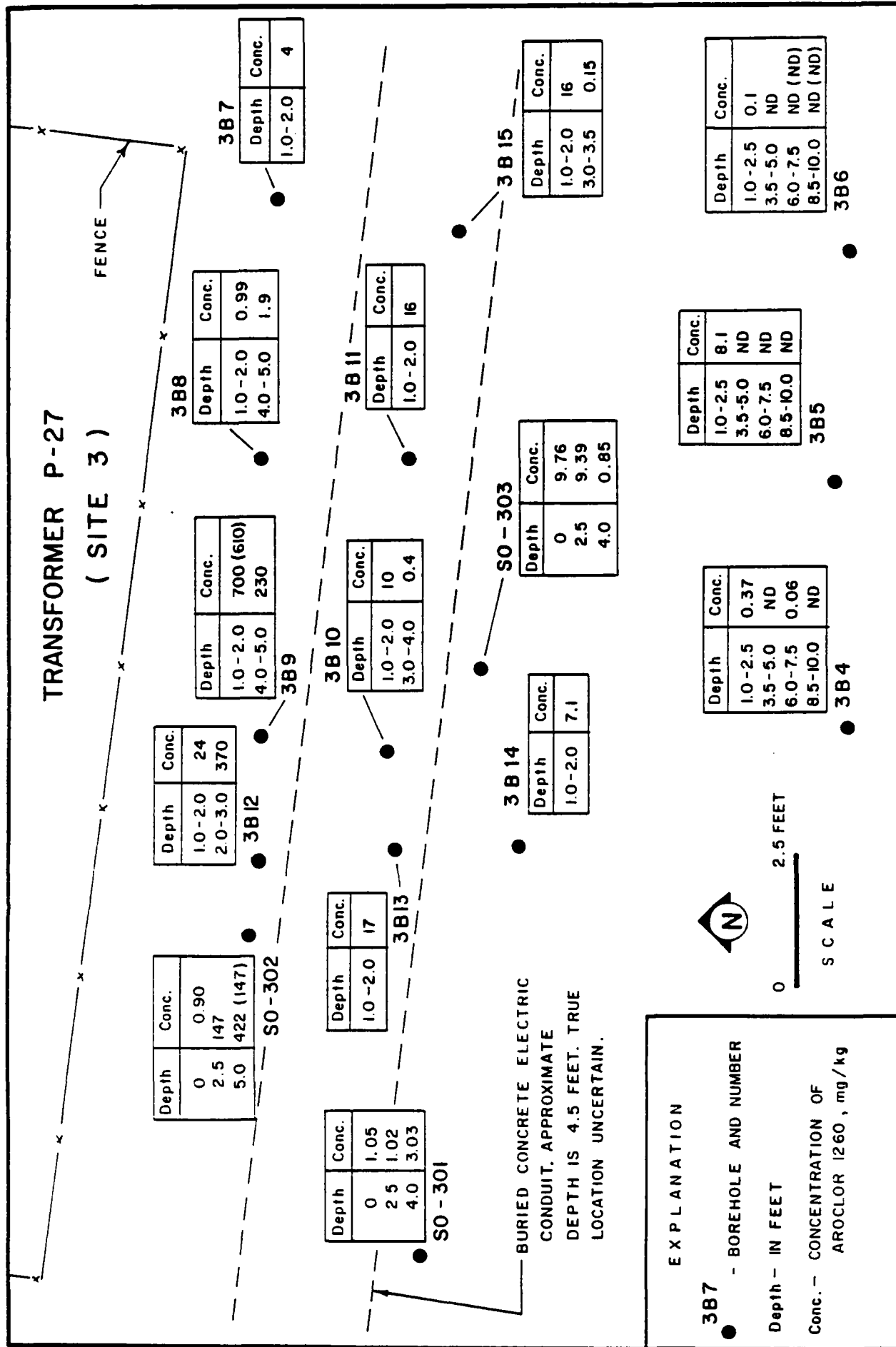


Figure ES-3. Distribution of PCB concentrations at Site 3.

Significance of Findings. During Stage 2, concentrations of Aroclor 1260 ranged from 0.06 to 700 mg/kg at depths between 0 to 7.5 feet bgs. Detected concentrations were highest next to the fence and decreased moving south, away from the fence. Prior excavation of the area nearest to the fence reached a depth of roughly 2 feet, which was apparently not deep enough to remove all of the PCB-contaminated soil.

Baseline Risk Assessment. PCBs are relatively inert, and therefore persistent compounds, with a low vapor pressure, a high affinity for soils, and low water solubility. Despite their low vapor pressure, they have a high Henry's Law Constant, which causes a higher rate of volatilization than might normally be expected. Volatilization of PCBs is believed to account for their global distribution. Once they have volatilized, the PCBs come back to earth by way of rain, snow, or dust particles. Adsorption to the organic material in soil or sediments is probably the major fate of Aroclor 1260. Once bound, the PCBs may persist for years with slow desorption providing continuous, low-level exposure to the surrounding area.

In humans exposed to PCBs, reported adverse effects include impairment of liver function, a variety of neurobehavioral and affective symptoms, minor birth abnormalities, and probably increased incidence of cancer (Clement Associates, 1985). The EPA weight-of-evidence category for PCBs is Group B2, a probable human carcinogen, indicating that there is sufficient evidence of carcinogenicity in animals, but inadequate evidence of carcinogenicity in humans (SPHEM, 1986). Three primary ways in which PCBs can affect terrestrial wildlife are outright mortality, adverse affects on reproduction, and changes in behavior (Clement Associates, 1985). Toxicity increases with the length of exposure and position of the exposed species in the food chain.

Transport of PCBs from this site could occur by physical removal of contaminated soil, surface runoff, or by airborne movement of fugitive dust or vapors. Transport in soil would be slow due to the low soil permeabilities and the strong tendency for PCBs to adhere to the soil; however, it does occur and the PCBs could eventually reach the groundwater. Migration of PCBs in the

groundwater is not likely due to the properties of PCBs and to the hydraulic conductivity of the water-bearing zone, which is estimated at between 10^{-4} and 10^{-10} cm/sec (Freeze and Cherry, 1979).

The PCB Aroclor 1260 found at Site 3 has two potential exposure routes: 1) inhalation of dust and 2) dermal exposure by direct contact with the soil. Because of the high PCB concentrations found at shallow depth, the volatilization of the PCBs and the slow degradation rates could result in inhalation of these contaminants by those working in the vicinity of the substation and those downwind of AF Plant 85. The prevailing wind direction is from the south-southwest with an average wind speed between 7 and 10 miles per hour. The city of Gahanna lies less than 2 miles to the northeast of, or downwind from, AF Plant 85, as do the four environmentally sensitive areas. Dermal exposure by direct contact with the soil could occur when work is done at the substation, which may also release fugitive dust.

At AF Plant 85 Site 3, the risk to both humans and wildlife is sufficiently high to warrant remedial action. PCBs are known carcinogens at small exposure dosages and concentrations of Aroclor 1260 at this site ranged from 0.06 to 700 mg/kg at depths of between 0 to 7.5 feet. Because of these high concentrations of PCBs at such a shallow depth and their ability to volatilize readily into the atmosphere, both the city of Gahanna and the environmentally sensitive areas downwind from the site are at some risk. Dermal contact at the PCB Spill Site is also probable and the threat to human health and wildlife is relatively high from this exposure route. Also, the high concentrations of PCBs at this site exceed the federal action level of 50 ppm provided for PCBs by 40 CFR Part 761 I. Therefore, cleanup of the PCB-contaminated soil (to a recommended 25 ppm PCBs) at Site 3 is necessary to reduce the threat to human health and wildlife and is required by law.

Discussion of Results for Fire Department Training Area (Site 4) and James Road Hazardous Waste Pad (Site 8)

The proximity of the Fire Department Training Area (FDTA, Site 4) and James Road Hazardous Waste Storage Pad (JRHWP, Site 8) has allowed these two sites to be grouped as one for the purpose of data analysis (Figure ES-2).

During Stages 1 and 2 a total of 15 boreholes were drilled at this combined site, 12 of which were converted to groundwater monitoring wells. Of these monitoring wells, five monitor the till, four monitor the outwash, and three monitor transitional lithologic zones.

One shallow and one deep water-bearing zone are present. Laboratory permeability tests performed on soil samples taken from two wells monitoring the till show a coefficient of permeability of 1.73×10^{-6} and 6.5×10^{-8} cm/sec. These values are within the range reported for glacial till in other areas (Freeze and Cherry, 1979). Sieve analyses performed on soil samples collected from the till also indicate that this formation is relatively impermeable. Water levels indicate the outwash is under artesian pressure at this combined site which implies communication from the shallow to the deep water-bearing zone.

Eighteen (18) soil samples were collected and submitted for analysis during Stage 2; three of the samples were from the FDTA and 15 were from the JRHWP. During the Stage 1 investigation, 20 soil samples from the FDTA and nine from the JRHWP were submitted for analysis. Groundwater samples were obtained from the four monitoring wells present at FDTA and the eight monitoring wells installed at JRHWP during the Stage 2 field investigation. Six groundwater samples were collected during Stage 1. Table ES-2 shows the maximum concentrations of contaminants found at this combined site.

Several soil and groundwater samples collected from this combined site during both stages of investigation indicated the presence of a variety of organic compounds. Trichloroethylene (TCE) was detected in four soil samples

Table ES-2. Maximum Concentrations of Contaminants
at IRP Sites, AF Plant 85, Columbus, Ohio.

Site	Media	Parameters*	Maximum Concentrations	Federal MCL/ Cleanup Standards
3	Soil	Aroclor 1260	700 mg/kg	25 mg/kg
4/8	Soil	Lead	25.1 mg/kg	NR
		Oil & Grease	210 mg/kg	NR
		1,2-DCA	0.0065 mg/kg	NR
		Methylene Chloride	0.204 mg/kg	NR
		PCE	0.012 mg/kg	NR
		T-1,2-DCE	0.449 mg/kg	NR
		TCE	189 mg/kg	NR
		Toluene	0.190 mg/kg	NR
		PAHs	3.1 mg/kg	NR
	Groundwater	+ TDS	660 mg/l	500 mg/l
		+ Chloride	39 mg/l	250 mg/l
		Fluoride	1.0 mg/l	4 mg/l
		+ Sulfate	100 mg/l	250 mg/l
		Arsenic	0.013 mg/l	0.05 mg/l
		Barium	0.22 mg/l	1(5) mg/l
		Lead	0.007 mg/l	0.05(0.005) mg/l
		Oil & Grease	1.6 mg/l	NR
		1,1,1-TCA	0.7 ug/l	200 ug/l
		Freon 113	5.9 mg/l	NR
5	Soil	Cadmium	1.02 mg/kg	NR
		Chromium	16.0 mg/kg	NR
		Lead	19.4 mg/kg	NR
		Oil & Grease	518 mg/kg	NR
	Groundwater	+ TDS	2,500 mg/l	500 mg/l
		+ Chloride	44 mg/l	250 mg/l
		Fluoride	1.7 mg/l	4 mg/l
		+ Sulfate	556 mg/l	250 mg/l
		Arsenic	0.012 mg/l	0.05 mg/l
		Barium	0.3 mg/l	1(5) mg/l
		Lead	0.0096 mg/l	0.05(0.005) mg/l
		Mercury	0.0026 mg/l	0.002 mg/l
		Toluene	0.5 ug/l	NR(2,000) ug/l

* = Only those metals which are regulated in groundwater have been listed here.

+ = Parameters with non-enforceable secondary maximum contaminant levels.

NR = Parameter not regulated in this medium.

() = Proposed MCLs.

Table ES-2. Maximum Concentrations of Contaminants
at IRP Sites, AF Plant 85, Columbus, Ohio.
(Continued)

Site	Media	Parameters*	Maximum Concentrations	Federal MCL/ Cleanup Standards
5 (cont.)	Surface Water	+ TDS	678 mg/l	500 mg/l
		+ Chloride	58 mg/l	250 mg/l
		+ Sulfate	80.3 mg/l	250 mg/l
		Barium	0.12 mg/l	1(5) mg/l
		Lead	0.0194 mg/l	0.05(0.005) mg/l
		Oil & Grease	2.3 mg/l	NR
		1,1,1-TCA	1.6 ug/l	200 ug/l
		BDCM	1.0 ug/l	**
		Chloroform	12.0 ug/l	**
		TCE	1.6 ug/l	5 ug/l
	Sediments	Barium	240 mg/kg	NR
		Cadmium	13 mg/kg	NR
		Chromium	207 mg/kg	NR
		Lead	292 mg/kg	NR
		Oil & Grease	7,325 mg/kg	NR
		PAHs	970 mg/kg	NR
		Methylene Chloride	1.0 mg/kg	NR
10	Surface Water	+ TDS	500 mg/l	500 mg/l
		+ Chloride	40 mg/l	250 mg/l
		+ Sulfate	68 mg/l	250 mg/l
		Barium	0.064 mg/l	1(5) mg/l
		Lead	0.003 mg/l	0.05(0.005) mg/l
	Sediments	Barium	130 mg/kg	NR
		Cadmium	1 mg/kg	NR
		Chromium	20 mg/kg	NR
		Methylene Chloride	1 mg/kg	NR
Perimeter Wells Groundwater		+ TDS	710 mg/l	500 mg/l
		+ Chloride	50 mg/l	250 mg/l
		Fluoride	1.2 mg/l	4 mg/l
		+ Sulfate	94 mg/l	250 mg/l
		Arsenic	0.008 mg/l	0.05 mg/l
		Barium	0.61 mg/l	1(5) mg/l
		Cadmium	0.04 mg/l	0.01(0.005) mg/l
		Lead	0.012 mg/l	0.05(0.005) mg/l

* = Only those metals which are regulated in groundwater have been listed here.

+ = Parameters with non-enforceable secondary maximum contaminant levels.

NR = Parameter not regulated in this medium.

() = Proposed MCLs.

** = BDCM and Chloroform are two of the four components of the total trihalomethanes group which has an MCL of 100 ug/l; combined concentrations of these four components cannot exceed 100 ug/l.

with concentrations ranging from 0.042 to 189 mg/kg. Although the high TCE value was confirmed in second column analysis, the concentration detected in the duplicate sample taken from this same depth was only 1.3 mg/kg. Trans-1,2-dichloroethylene (t-1,2-DCE), a TCE breakdown product, was detected in one of the three soil samples collected from one borehole (0.449 mg/kg). Neither TCE nor t-1,2-DCE were detected in groundwater samples collected at Combined Site 4/8.

1,1,1-Trichloroethane (1,1,1-TCA) was detected in one soil sample at a concentration of 0.0052 mg/kg and two groundwater samples (1.1 and 0.7 µg/L). 1,1-Dichloroethane (DCA) and 1,2-DCA were also detected in soil samples from this combined site. 1,1-DCA was detected in one soil sample (0.0062 mg/kg), while 1,2-DCA was detected in soil samples from three boreholes (0.0078 to 1.9 mg/kg). 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113) was detected in one well at a concentration of 5.9 mg/L, but was not detected in any of the soil samples at this combined site.

During Stage 1, toluene and methylene chloride were detected in soil samples from all the boreholes, with concentrations ranging from 0.018 to 0.204 mg/kg. These analytes were not detected in groundwater samples.

During Stage 2, quantities of several polycyclic aromatic hydrocarbons (PAHs), ranging in concentration from 0.6 mg/kg [indeno(1,2,3-c,d)pyrene] to 3.1 mg/kg (fluoranthene), were detected in a soil sample taken from one borehole. Oil and grease were found in all soil samples collected during the Stage 1 investigation, with concentrations ranging from 24.5 to 210 mg/kg. During Stage 2, oil and grease were detected as semi-quantified SW 8270 compounds in four soil samples. Oil and grease were detected in all six Stage 1 groundwater samples with concentrations ranging from 0.5 to 1.6 mg/L; Stage 2 groundwater samples were not analyzed for oil and grease.

Lead was the only metal detected in soils. It was detected in all soil samples collected from the FDTA, ranging from 5.59 to 25.11 mg/kg. Stage 2 investigations included analysis of a fairly complete suite of metals in

groundwater. These data were compared to background levels computed from the AF Plant 85 perimeter wells. None of the metals detected at this combined site exceeded any of their respective MCLs or designated levels.

Significance of Findings. In determining the significance of contaminants found at Combined Site 4/8, chemical concentrations were compared with the current and proposed federal primary maximum contaminant levels (MCLs), where established for parameters in groundwater. The state of Ohio adopted the federal MCLs as state standards in May 1989. As no federal or state regulatory standards exist for contaminants in soils, guidelines from the literature were used for comparison. The primary source used for this comparison was the state of California Designated Levels, which were developed for analytes in soils at a hypothetical "average" site. These levels were developed by the California Regional Water Quality Control Board to show the use of this methodology in generating contaminant threshold levels in soils for the protection of groundwater and surface water resources. Since these designated levels were computer-generated using specific soil types found in California, caution should be used in comparing these to the concentrations, particularly inorganic, found in soil samples collected at AF Plant 85. These levels were established for illustrative purposes only, and they have no official status or legal significance, even in California. Where California designated levels were not provided for a particular analyte, other literature sources were consulted, and the same precautions should be used in these comparisons as well.

Of the TCE concentrations found in soil samples at the FDTA, only the 189 mg/kg value exceeded the designated level of 5 mg/kg. However, Cleland and Kingsbury (1977) provide a soil Ambient Multimedia Environmental Goal (AMEG) of 1,000 mg/kg for TCE. An AMEG is the approximate level of a contaminant "below which unacceptable negative effects in human populations or in natural biological communities should not occur with continuous exposure" (Fitchko, 1989). The one 1,1-DCA concentration did not exceed the designated level (20 mg/kg) and only two of the ten 1,2-DCA concentrations were above the 1.0 mg/kg guideline for soils. The designated levels for t-1,2-DCE, toluene, and

1,1,1-TCA (16, 100, and 200 mg/kg, respectively) were not exceeded by any concentrations found in soils collected at this combined site. The primary MCL for 1,1,1-TCA (200 $\mu\text{g/L}$) was also not exceeded by concentrations found in the groundwater. Although an MCL has not been established for the presence of Freon 113 in groundwater, California lists 1.2 mg/L as the state action level for this parameter, which was exceeded by the concentration detected in groundwater from well PG803. The California designated level for the PAH compounds is 0.0028 mg/kg, which was exceeded by all PAH concentrations found at this location.

No federal or state regulatory standards exist for the presence of oil and grease in soils. The free petroleum products which tend to stress the environment most are gasoline and diesel fuels (C4 to C12 and C10 to C23 hydrocarbons, respectively). The fuel components of major concern are benzene, toluene, xylene, and ethylbenzene (BTX&E) because: 1) they are a serious threat to human health, 2) they have the potential to move through soil and contaminate groundwater, and 3) their vapors are highly flammable and explosive. The hydrocarbons detected in the soil samples collected during the installation of monitoring well 4MW4 were considerably heavier than those in gasoline and diesel (C25 to C35) and no BTX&E were detected, indicating that the above risks would not be present.

The organic compounds, as well as the lead, found at the FDTA are likely the result of past fire training activities. The toluene, methylene chloride, 1,1,1-TCA, 1,1-DCA, 1,2-DCA, t-1,2-DCE, and petroleum products found at JRHWP could be the result of the spills and leaks which have occurred at the storage pad. TCE and 1,1,1-TCA are used as solvents and were reported to have been stored at this site. In addition, waste solvents were also reportedly burned with fuels during fire training exercises, which could be the source of the high TCE value in the FDTA. The PAHs detected at JRHWP are byproducts of the coal tar distillation process and are also found in some of the heavier petroleum products, such as asphalt. It was thought by some of the field personnel that the sample containing the PAHs was obtained from a borehole penetrating an old road bed.

Although concentrations of the above compounds in soils are not regulated by federal or state agencies and none of the contaminants found in groundwater exceeded primary MCLs, baseline risk assessments were performed on the PAHs, TCE, and Freon 113 due to the relatively high concentrations found at this combined site.

Baseline Risk Assessment. Data gathered on PAHs has been largely inferred from research conducted on benzo(a)pyrene, which will be used here as the representative compound. The physical, chemical, and fate data obtained from the Superfund Public Health Evaluation Manual (SPHEM, 1986) indicate that this compound has a very high affinity for soil or sediment, would strongly adsorb to suspended particulate matter, and is not very soluble in water. The toxicity data for benzo(a)pyrene lists a carcinogenic potency factor of $11.5 \text{ mg/kg/day}^{-1}$ using the oral route (SPHEM, 1986). At a cancer risk level of 10^{-4} , the acceptable benzo(a)pyrene dose for short-term exposure for a 70 kg person is 0.50 mg/day; for a 10^{-6} cancer risk, the short-term dose is 0.005 mg/day (AGWSE, 1989). Of the nine PAHs found at Site 8, four have sufficient evidence accumulated on them to be classified as carcinogenic in animals. Those chemicals which have been found to be carcinogenic have also been found to be mutagenic (Clement Associates, 1985). The EPA weight-of-evidence category for benzo(a)pyrene is Group B2, a probable carcinogen, indicating that there is sufficient evidence of carcinogenicity in animals, but inadequate evidence in humans.

The physical, chemical, and fate data for TCE indicate that it could leach into groundwater fairly readily, is highly volatile, moderately adsorbs to organics, and can bioaccumulate to some degree (Clement Associates, 1985). TCE has been shown to be carcinogenic in long-term, high dosage laboratory tests on animals, effecting the kidneys, liver, nervous system, and skin. TCE has a low acute toxicity and the median lethal dose (LD_{50}) in several species ranged from 6,000 to 7,000 mg/kg. No information was found on the effects of TCE on marine life, domestic animals, or terrestrial wildlife (Clement Associates, 1985). For humans, the 10^{-6} cancer risk associated with lifetime exposure to TCE in drinking water is estimated to be $2.7 \text{ } \mu\text{g/L}$.

The physical, chemical, and fate data for Freon 113 indicate this compound is quite volatile, is slightly soluble in water, and has a moderate potential for sorption to organic materials. There are very few data available concerning the risks of Freon 113. However, human exposure to vapor concentrations of 4,500 ppm or more can affect the nervous system. Freon 113 had a mild dermal effect on rabbits at a concentration of 500 mg/L and the LD₅₀ due to ingestion in rats was 43 gm/kg. The compound is noncarcinogenic with an acceptable oral route intake in chronic situations of 3.00 mg/kg/day (SPHEM, 1986). This would allow a 70 kg person (drinking 2 liters of water per day) to ingest 2,100 mg/day.

The sources for the PAHs or the Freon 113 have not been positively identified. As stated previously, however, field personnel suspect that the sample containing the PAHs was collected from an old roadbed. There is no documentation of Freon 113 (which is commonly used as a solvent) being stored at the JRHWP or of a spill having occurred, but this does seem to be the most likely source. Since TCE is used as a solvent and mixed solvents were stored at JRHWP, it is likely that leaking storage drums were the source of the small amount of TCE breakdown products detected in the soils at this site. The reportedly high value of TCE found at the FDTA is likely a residual from previous fire training exercises.

PAHs were only found in one soil sample at JRHWP, indicating they are not presently being transported to the groundwater. These organic compounds could reach groundwater by leaching from contaminated soils; however, these chemicals are only slightly soluble in water and adsorb readily to particulate matter. Also, the hydraulic conductivity in the till is estimated to be between 10^{-6} and 10^{-8} cm/sec, suggesting that the compounds found at this site would not be readily transmitted through the groundwater. Therefore, groundwater would not be a likely transport medium for PAHs. Atmospheric transport is possible either through adsorption to airborne particulates or by volatilization of those PAHs with low molecular weights. The PAHs were found in one soil sample at a depth of between 4.0 to 5.5 bgs and would only enter the atmosphere if these soils were disturbed.

Freon 113 was found in a monitoring well screened in the till and was not detected in either of the other downgradient wells screened in the till or in any of the wells in the vicinity screened in the deeper outwash. It appears that Freon 113, which is stable in water, is not migrating to other monitoring wells. This compound was not detected in any of the soil samples collected at Sites 4 and 8. Since Freon 113 is quite volatile, it is possible that any previous concentrations in soil close to the ground surface could have volatilized and entered the atmospheric medium and were transported downwind.

The three exposure routes of ingestion, inhalation, and dermal contact are possible at these sites. Inhalation and dermal contact could take place if any future activities at this combined site occurred which disturbed the soils, such as during any new construction. The receptors would be those individuals working at the site during such activities, as well as the downwind city of Gahanna. The compounds found in the soil do not occur in the groundwater; therefore, ingestion is only a concern for Freon 113. The compound was detected in the water-bearing zone of the till. However, the till is not used as a water supply, primarily due to the low yield of the water-bearing formation. Consequently, there are no present receptors nor are there likely to be in the future.

There does not appear to be a threat to human health or the environment by the presence of PAHs in the one soil sample collected at JRHWP. These contaminants are of limited areal extent and total PAH concentration did not exceed the tentative Netherlands guidelines which would warrant further investigation of these compounds in soils. They were not detected in groundwater samples collected from monitoring wells at this combined site. Also, since these contaminants are not very soluble in water and they are highly adsorbent onto soil, the likelihood of them entering the groundwater to be consumed is low, especially considering the low yield of the water-bearing formation. Finally, the depth at which the PAHs were found is such that the only risk to health would occur if they were excavated.

Freon 113 was found in only one groundwater sample at a concentration of 5.9 mg/L; and, it was not detected in any of the soil samples. This compound is noncarcinogenic with an acceptable oral route intake in chronic situations of 30 mg/kg/day, which would allow an average person to ingest 2,100 mg/day. At the present concentration at this site, this would allow a person to drink 356 liters of freon-contaminated water per day, which is highly unlikely. Also, Freon 113 was detected in a transitional water-bearing zone, which is not used as a water supply due to its low yield. Therefore, it is not likely that the Freon 113 found at this site will be a threat to human health and the environment.

TCE and its breakdown products were detected in relatively low concentrations, none exceeding established standards or guidelines. The one exception to this is the 189 mg/kg concentration found in one soil sample. Although confirmed in second column analysis, this value may be suspect due to the low concentration found in its duplicate. However, assuming that this high value is valid, the health risk from this compound was examined. TCE has a high water solubility, yet it was not detected in the groundwater samples collected from the downgradient well monitoring the borehole in which it was found. Also, TCE is highly volatile and because of the depth at which this compound is found, the only potential risk to health from TCE would occur during excavation at this site. Therefore, it appears that no receptors for this compound presently exist and the only risk to human health and the environment would possibly occur if the soil at the FDTA were disturbed.

Discussion of Results for Mason's Run (Site 5)

Mason's Run is located in the central area of the Plant. It enters the Plant boundaries from the Port Columbus Airport, flows south through the facility, and exits near the entrance to AF Plant 85 on East Fifth Avenue (Figure ES-2). Mason's Run is channeled with a concrete culvert through most of its extent within the Plant boundaries.

Two soil, two groundwater, and seven sediment samples were collected and analyzed during Stage 1. Stage 2 sampling consisted of collecting four groundwater samples, two surface water samples (one upstream and one downstream), and three sediment samples. The maximum concentrations of contaminants at this site are found in Table ES-2.

Both organic and inorganic constituents were detected in soil, sediment, groundwater, and surface water samples collected from Mason's Run. The most prevalent organic compounds found at this site were oil and grease and other related petroleum products, including PAHs. Oil and grease were detected in Stage 1 soil samples collected during the installation of the two monitoring wells, with concentrations ranging from 93.3 to 518 mg/kg. Groundwater samples collected from these same wells showed oil and grease concentrations of 1.4 and 1.1 mg/L. Surface water samples collected from both the upper and lower reaches of Mason's Run contained oil and grease concentrations from 1.1 to 2.3 mg/L. The highest concentrations of petroleum products found at Site 5, however, were in sediment samples, particularly those collected upstream from the concrete weir located on the southern extent of Mason's Run. Here concentrations ranged from 1,766 to 7,325 mg/kg, while oil and grease values in sediments from the northern extent ranged from 72.9 to 454 mg/kg. During the Stage 2 investigation, the sediment sample collected immediately upstream from the concrete weir contained a total petroleum product (semi-quantified SW8270 compounds) concentration of 760 mg/kg. Also of importance in this sample were the individual PAHs detected in concentrations ranging from 2.7 to 970 mg/kg. About 100 feet downstream from the weir, PAH concentrations in the sediment sample ranged from 1.5 to 20 mg/kg. PAHs were not detected in any of the surface water or groundwater samples collected at Site 5.

Other organic compounds detected at Site 5 were 1,1,1-TCA, TCE, BDCM, chloroform, and methylene chloride. During the Stage 1 investigation, 1,1,1-TCA was detected in one surface water sample at a concentration of 1.6 µg/L at the downstream sampling point; and during Stage 2, it was detected at concentrations of 0.5 and 1.1 µg/L at the same location. TCE, BDCM, and chloroform were also detected at this surface water sampling location at

concentrations of 0.5 to 1.6 $\mu\text{g/L}$, 1.0 to 5.6 $\mu\text{g/L}$, and 1.3 to 3.8 $\mu\text{g/L}$, respectively. Methylene chloride was detected in two Stage 2 sediment samples in concentrations of 1.0 and 0.9 mg/kg.

Total dissolved solids (TDS) and sulfate were detected in both groundwater and surface water samples. TDS concentrations in groundwater ranged from 464 to 2,500 mg/L and in surface water samples ranged from 330 to 678 mg/L. Sulfate was detected in all groundwater samples collected, with concentrations ranging from 73.6 to 556 mg/L, and in surface water samples, with values ranging from 49.2 to 80.3 mg/L.

A number of metals were detected in all of the sampling media at this site. Because of the large number of metals and the fact that they are naturally occurring, only those with current or proposed primary MCLs in groundwater were evaluated and compared to background levels from the AF Plant 85 perimeter wells. The exceptions to this are the metals found in sediment samples, which were also compared to U.S. EPA guidelines developed by Region V for the evaluation of Great Lakes harbor sediments (USEPA, 1977, as adapted by Fitchko, 1989).

Results from the aquatic survey conducted on Mason's Run are presented in full in Appendix I. Seining the creek at both locations did not produce any fish, suggesting that none were inhabiting either stretch of Mason's Run during the study period. Results of the benthic survey indicated that the diversity of organisms upstream and downstream of the facility are essentially the same. Also, the five taxa which dominated the upstream and downstream sites are similar. However, there were significantly higher densities upstream than downstream. The overall conclusion of the aquatic survey is that the upstream site can support a higher density of organisms similar in composition to the downstream site. The reduced densities at the downstream site may be due to the habitat differences, contaminant differences in the sediments, or a combination of the two. The upstream habitat was more complex with algal mats, detritus, and soft mud available to bottom organisms for food and shelter. However, the downstream habitat consisted largely of bare rock with the absence

of a thick layer of detritus. In addition, of the 55 semi-volatile organic contaminants tested for in the sediments at both sites, 16 were detected downstream; none were detected upstream.

Significance of Findings. In determining the significance of contaminants found at Mason's Run, chemical concentrations were compared with the current and proposed federal primary maximum contaminant levels (MCLs), where established for parameters in groundwater. As contaminants are not federally regulated in soils, guidelines from the literature will be used for comparisons. The primary source used for this comparison is the state of California Designated Levels, which were discussed under the analysis of Combined Site 4/8 contaminants. Where California Designated Levels were not provided for a particular analyte, other literature sources were consulted as guidelines.

No federal standard exists for the presence of oil and grease in soils. However, the free petroleum products which tend to stress the environment most are gasoline and diesel fuels (C4 to C12 and C10 to C23 hydrocarbons, respectively), while the fuel components of major concern being benzene, toluene, xylene, and ethylbenzene (BTX&E). The hydrocarbons (semi-quantified SW 8270 compounds) detected in the Stage 2 sediment samples collected from Mason's Run tended to be heavier than those in gasoline and diesel and no BTX&E were detected, suggesting that the above risks would not be present. The highest concentration of oil and grease (2.3 mg/L during Stage 1) detected in surface water collected from Mason's Run did not exceed the state of Ohio wastewater discharge limit of 10 mg/L for these compounds. Ohio also has adopted a marginally enforceable water quality standard which states that surface water must be "free from floating debris, oil, scum and other floating materials entering waters as a result of human activity in amounts sufficient to be unsightly or cause degradation."

The California Designated Level for PAH compounds in soils is 0.0028 mg/kg. All PAH concentrations detected in the during Stage 2 sediment samples collected immediately upstream from the concrete weir and about 100 feet

downstream from the weir exceed this level, with values ranging from 2.7 to 970 mg/kg and 0.8 to 20 mg/kg, respectively. In addition, the tentative Netherlands soil criteria list the concentration of 20 mg/kg (dry weight) total PAHs as the delimiting value for soil quality having potential for harmful effects on human health or the environment and requiring further investigation (Fitchko, 1989). Total PAHs for these contaminated sediment samples were over 7,000 mg/kg and over 100 mg/kg, respectively.

None of the other organic compounds detected at Site 5 exceeded their primary MCLs.

It was found that none of the regulated metals detected in either the groundwater or surface water samples collected at Mason's Run exceeded their primary MCL nor their high normal background level, except for lead. Also, none of the regulated metals detected in soil samples exceeded the California designated levels. However, the sediment samples collected from along Mason's Run during Stage 2 do contain very high concentrations of metals, when compared to U.S. EPA guidelines developed by Region V for the evaluation of Great Lakes harbor sediments (USEPA, 1977).

The primary zone of contamination is the sediment along the lower reaches of Mason's Run, both upstream and downstream from the concrete weir. The secondary zone of contamination is the groundwater found in the same vicinity as the contaminated sediments. The sediment samples of concern were collected just upstream and about 100 feet downstream of the oil skimmer system/concrete weir. Both of these samples showed the presence of PAHs. As PAHs are found in petroleum products, the likely source of these contaminants is the oil from past spills trapped in or leaking from the skimmer system. Although the volume of sediments contaminated with PAHs is quite small (<1 cubic yard) and concentrations of these compounds are not regulated by either the federal or state agencies, a baseline risk assessment was prepared of PAHs due to the high concentrations and toxicity of the compounds found.

Baseline Risk Assessment. The PAHs are derived from the distillation of coal tar and are found in the heavier petroleum and coal tar products, such as oil and asphalt (Sax and Lewis, 1987; R. Miller, pers. com., 1989). A discussion of the physical, chemical, and fate data, as well as the toxicity data, for benzo(a)pyrene was provided in the baseline risk assessment section for Combined Site 4/8. Of the 12 PAH compounds found at Mason's Run, five have sufficient research evidence accumulated on them to be classified as carcinogenic in animals (Clement Associates, 1985). In a study of benthic organisms in Puget Sound, it was found that PAH concentrations ranging from 0.5 to 8.0 mg/kg (dry weight) in sediments had a statistically significant effect on the biota. Concentrations above these values resulted in mortality and benthic infaunal population decreases (Fitchko, 1989).

The presence of higher PAH concentrations in the sediment upstream of the weir as compared to the sample collected downstream indicates that, although the weir is impeding sediment transport, some of the contaminant-laden sediments are migrating downstream. Sediment transport from behind the weir would be via the surface water in Mason's Run. Although these compounds were not detected in the surface water, their presence in the sediment sample collected 100 feet downstream from the weir suggest that they are transported during times of heavy precipitation or other activities in the vicinity of the weir which would disturb the dammed sediments.

Although the actual sources of PAHs in the sediment at Mason's Run are unknown, it is likely that they are the oil and other petroleum products from the numerous spills which the run has received over the years. The PAH-contaminated sediments were found just behind the oil skimmer; therefore, the oil could actually be coming from the skimmer itself, either because of leaks or because some of the petroleum product could have spilled during skimmer drainage.

The transport medium for PAHs at Mason's Run is via sediment migration in surface waters. PAHs are adsorbed to suspended particulate matter, especially those high in organic content. The available information suggests that these

compounds can accumulate in the sediment and biotic portions of the aquatic environment, and that physical movement of the sediments or uptake in the food chain are probably the dominant aquatic transport processes. PAHs could reach groundwater by leaching from the polluted sediment; however, these chemicals are only slightly soluble in water (1.20×10^{-3} mg/L) and no evidence of these contaminants was found in the wells monitoring this site. In surface waters any dissolved PAHs would probably undergo rapid and direct photolysis. Oxidation of these chemicals by chlorine and ozone is possible if sufficient quantities of these catalysts are present. No PAHs were found in the surface water of Mason's Run.

The chemicals can be bioaccumulated but are found to metabolize quickly and then be eliminated. Bioaccumulation and biodegradation are probably the ultimate fate processes for PAHs (Clement Associates, 1985.)

The primary routes of exposure would be dermal contact with the sediments or ingestion of fish. No fish were seen during the ecology study, although a school of small fish was noted during the Pre-survey of Phase II. This would indicate that the receptors are those users downstream, the most immediate being the community of Whitehall. However, due to the very small amount of contaminant-laden sediments (<1 cubic yards), the likelihood that enough of the compounds would come into contact with human receptors is negligible. Additional receptors via the dermal contact route would be those personnel who maintain the oil separator system.

The concentrations of PAHs immediately upstream from the oil/water separator varied between 50 to 970 mg/kg, which are relatively high values when compared to the acceptable short-term dose allowance of 0.05 mg/day (AGWSE, 1989). Also, these concentrations are much higher than those given in the Puget Sound study of benthic organisms. The benthic study on Mason's Run did indicate a significant reduction in density (numbers of individuals within a population) from the upstream site. This, however, could also be attributed to the substrate (creek bottom) which is not conducive to benthic colonization. Because the area of contaminated sediments is so limited, it is doubtful that

these PAHs would have an adverse impact on either human health or the environment outside of the immediate area. However, due to the carcinogenic nature of many of the PAHs, there is some risk at the site. Even this risk can easily be alleviated with the removal of only <1 cubic yard of sediment (see Recommendations), a very minor remedial action that does not warrant a Technical Document Supporting a Remedial Action Alternative (TDSRAA), and can be alleviated through better maintenance of the oil/water separator system. In fact, it recently was reported that sediments under the oil skimmer are now regularly removed by the Plant operator (Carl Stoltz, writ. com., 1990).

Discussion of Results for Turkey Run (Site 10)

Approximately 375 feet of Turkey Run traverses the western edge of AF Plant 85; of this, roughly 60 feet are contained in a steep-sided open concrete culvert (Figure ES-2). After passage through the Port Columbus International Airport, Turkey Run joins Mason's Run approximately 2 miles south of the AF Plant 85. Turkey Run is an intermittent stream which recharges the groundwater in the fall, following a rainfall event, and discharges groundwater in the spring.

During Stage 2, two surface water samples and two sediment samples were collected and submitted for chemical analyses. The maximum concentrations of contaminants found at this site are found in Table ES-2. Methylene chloride was the only organic compound detected in samples collected from Turkey Run. It was found in both sediment samples at a concentration of 1.0 mg/kg. No federal or state MCLs have been established for this chemical.

Significance of Findings. A number of metals were detected in both the surface water and sediment samples collected at this site. Because of the large number of metals and the fact that they are naturally occurring, only those with current or proposed primary MCLs in groundwater were evaluated and compared to background levels from the AF Plant 85 perimeter wells. Exceptions to this are the metals found in sediment samples, which were also compared to U.S. EPA guidelines developed by Region V for the evaluation of Great Lakes

harbor sediments (USEPA, 1977). It was found that none of the regulated metals detected in the surface water samples collected at Turkey Run exceeded their primary MCL or their high normal background level. The sediment samples collected from along Turkey Run during Stage 2 do contain very high concentrations of metals (iron, manganese, nickel, barium, zinc, and copper) when compared to U.S. EPA guidelines developed by Region V for the evaluation of Great Lakes harbor sediments (USEPA, 1977).

Several factors have been considered in determining that there is no evidence of a threat to human health or the environment at Site 10, Turkey Run. First of all, the metals are apparently bound up in the sediments since concentrations of the same constituents in the surface water are low and do not exceed any MCLs; and, this surface water is not used as a source of drinking water. Access to the facility is restricted, which eliminates the possibility of incidental dermal contact with and ingestion of sediments by small children. Therefore, the possible threat to human health is not present.

Perhaps the benthic community might be impacted by the presence of these high metals concentrations. However, according to the Ohio Division of Natural Areas and Preserves, the only endangered or threatened species or critical habitats within 5 miles of the facility are located upstream, to the northeast of Plant 85. Therefore, there is no risk of exposure to these environmentally sensitive areas from Plant activities around Turkey Run. Further, Turkey Run flows through a very industrialized setting and a healthy natural stream environment could not be achieved unless more than the Plant's 375-foot segment of this low-flowing stream were involved in cleanup activities. Finally, it should be recalled that no specific regulatory standards exist for metal concentrations in sediments.

Discussion of Results for Perimeter Monitoring Wells

Plant-wide monitoring was initiated at the beginning of the Stage 2 investigation to provide water quality data on groundwater influenced by Plant activities. This involved establishing upgradient monitoring wells to provide

data on groundwater entering the Plant area and at downgradient wells to measure the quality of the water leaving the Plant. These wells were established in both water-bearing zones: the till and the outwash. The Plant-wide wells are located along the perimeter of the facility (Figure ES-2). In addition, one well installed during the Stage 1 investigations at Site 2 has been included with the Plant-wide monitoring system.

During the installation of the eight monitor wells, soil samples were collected and analyzed for grain size distribution, moisture content, and permeability. This information, along with lithologic logs, has provided a better understanding of the geology at the facility.

In seven wells, soil samples taken from between 4 to 6 feet bgs are composed primarily of silt and clay-sized particles with an average percent moisture of 21.7 and the permeability ranging from 1.12×10^{-8} to 2.5×10^{-8} cm/sec (averaging 1.57×10^{-8} cm/sec). This indicates a uniformity in the uppermost zone of the till, as well as the impermeability of the Wisconsin till.

Analysis of three samples taken from the interval of 13 to 15 feet bgs suggest this sampling interval may correspond to the semi-confining bed found across AF Plant 85. The average grain size distribution indicated 50% was retained on the No. 200 sized sieve. The percent moisture averaged 13.6. The confining layer probably acts as a leaky confining bed, allowing some communication between the water-bearing zones of the till and the outwash.

The information gathered from the above analyses and examination of the lithologic logs indicates that the Plant site is underlain with impermeable till material, ranging from 10 to 35 feet thick. This Late Stage Wisconsin till is comprised of mostly silty clay with some outwash features associated. In some boreholes (such as 9MW3) this till grades into the relatively well-sorted sand and gravel outwash of the Early Wisconsin Stage. Where found in the deeper boreholes (9MW4), this outwash is underlain by a thin layer of clay-rich till. In well 9MW7, located in the southwest corner, the outwash appears

to be interbedded with till-like zones. No outwash was encountered in well 9MW5, the easternmost well.

Bedrock was encountered in one well at 14 feet bgs and in two wells, at 40 feet bgs. The Wisconsin till and Illinoian outwash were also encountered. Bedrock was not encountered in any of the western Plant-wide wells. It is expected that the bedrock in the western portion of the Plant lies approximately 200 feet bgs where the preglacial Groveport River drainage is present.

The potentiometric surfaces of the Wisconsin till and that of the Illinoian outwash indicate a general flow to the southwest. The potentiometric surfaces for both the till and the outwash show a small high or mound in the vicinity of the James Road Hazardous Waste Pad. Water level data taken from these wells in December 1988 indicate the outwash is under artesian pressure; that is, the water levels rose above the level at which the water-bearing zone was encountered. Slug tests performed in these wells indicate hydraulic conductivities of between 1.3×10^{-2} to 8.8×10^{-3} cm/sec (Papadopolus and others method) and 1.2×10^{-2} to 4.6×10^{-2} cm/sec (Hvorslev method). These figures indicate the material is a silty to clean sand (Freeze and Cherry, 1979), which corresponds to the lithologic descriptions.

One groundwater sample was collected from each of the eight wells in the system. Soil samples collected from this site were not analyzed for chemical parameters. The maximum concentrations of contaminants found at this site are shown in Table ES-2. Toluene was the only organic compound found in groundwater sampled from the perimeter wells. It was detected in one well at a concentration of $0.7 \mu\text{g/L}$. This value was not confirmed in the second column analysis; therefore, further discussion of this parameter is not warranted.

Significance of Findings. Analyte concentrations found in groundwater samples from the perimeter wells were used to compute background levels for comparison with inorganic concentrations at the various sites around the Plant. Mean chemical concentrations were obtained by adding the concentration values from each background sample and dividing the total by the number of samples.

Since these calculations are for naturally occurring metals, their presence in groundwater is expected; therefore, values for analytes with concentrations below the detection level were computed into the mean at the detection level, rather than zero. In order to more accurately compare chemical concentrations for the various sites with estimated background levels, ranges for acceptable concentrations were established by adding two standard deviations to the mean of each parameter (see Table 4-14). The value at the top end of the range is referred to as the high normal background level (HNBL).

TDS were recorded in all of the perimeter wells, with values ranging from 530 to 710 mg/L, all of which exceeded the non-enforceable Secondary MCL of 500 mg/L. A number of metals were detected in the groundwater samples collected from the perimeter wells. Because of the large number of metals and the fact that they are naturally occurring, only those with current or proposed primary MCLs in groundwater were evaluated. Aluminum, arsenic, barium, chromium, copper, fluoride, mercury, and selenium concentrations in groundwater samples collected at this site did not exceed their respective primary MCLs or HNBLs; this medium was not analyzed for the other regulated inorganics (cyanide and nitrate). The proposed primary MCL for cadmium (0.005 mg/L) was exceeded in two of the perimeter wells and the lead concentration in one well (0.012 mg/L) exceeded the proposed primary MCL of 0.005 mg/L. The current MCLs for both cadmium and lead, however, were not exceeded. The copper concentration in one groundwater sample (0.21 mg/L) exceeded its HNBL of 0.17 mg/L, but not its proposed primary MCL of 1.3 mg/L.

A comparison of the locations of one of the wells containing cadmium and the one containing lead with the map of the potentiometric surface of the shallow wells installed at AF Plant 85 suggests that these wells monitor off-Plant activities. Therefore, the elevated cadmium and lead values in these wells are not likely to be attributable to Plant activities. The only elevated cadmium value which could be attributed to Plant activities was found in well 9MM6; however, this cadmium value is equal to the present primary MCL (0.01 mg/L); and because this well is screened in the till, it is unlikely that significant migration of this contaminant will occur. The hydraulic

conductivity in the till is estimated to be between 10^{-6} and 10^{-8} cm/sec. According to the EPA Hazardous Ranking System, the hydraulic conductivity range for various materials is $>10^{-3}$ to $<10^{-7}$ cm/sec, which indicates that the till is very low in permeability. Also, the till is not used as a drinking water supply, primarily due to the low yield of this water-bearing formation.

The absence of significant contamination in the Plant-wide perimeter wells negates further discussion of contaminant migration or of health and environmental threats.

PRIORITIZATION OF SITES FOR REMEDIAL ALTERNATIVES

Sites studied during the RI/FS Stage 2 investigation were ranked in order of the severity of contamination as listed below. The ranking system was developed using a variety of information. Indicator chemicals were selected for each site based on both the health hazard of the contaminant and its extent at the site. Each indicator chemical was examined by sample media, noting the number of times the parameter was analyzed, the number of detections of that analyte, the percent of detections, the percent of detections exceeding a standard or criterion, and a multiplier indicating how many times the maximum concentration of the contaminant exceeded the standard or criterion. Then, each contaminant was given a Source Hazard score using a method adapted from the Air Force Defense Priority Model. Also used in ranking the sites were observations made at each site, such as the apparent potential for contaminant migration.

The sites were ranked as follows:

1. PCB Spill Site (Site 3)
2. Fire Department Training Area (Site 4) and James Road Hazardous Waste Storage Pad (Site 8)
3. Mason's Run (Site 5)
4. Turkey Run (Site 10)
5. Perimeter Wells.

FEASIBILITY STUDY

Of the six sites investigated at AF Plant 85, only one was chosen for remedial action planning based on its potential threat to human health and the environment. This was Site 3, the PCB Spill Site, where concentrations of PCBs that pose a risk to human health and environment were found. A Feasibility Study was performed for this site to determine the appropriate remedial actions for cleanup of the PCB-contaminated soil.

The purpose of the three-phase Feasibility Study (FS) process was to develop remedial action alternatives which could achieve acceptable levels of cleanup for specific sites. This phased process began with the identification of preliminary alternative remedial action (FS-I); proceeded with the initial screening of alternatives (FS-II); and concluded with a detailed analysis and final screening of the alternatives (FS-III).

The primary purpose of the FS-I was to develop remedial alternatives that would protect human health and the environment. This involved developing remedial action objectives and general response actions for the specific site conditions. Then, applicable technologies and technology process options were identified and evaluated. Based on their evaluation, representative technology process options were chosen and then assembled into alternatives that represented a range of treatment options. The alternatives assembled for the PCB Spill Site were: 1) No Action, 2) Perimeter Fencing, 3) Multi-Media Soil Cap, 4) In-Situ Solidification/Chemical Fixation, 5) Excavation/KPEG Chemical Treatment/Backfilling/Incineration, 6) Excavation/Rotary Kiln Incineration/Backfilling, and 7) Excavation/Landfilling/Backfilling.

The No Action alternative was retained through all three phases of the FS process to be used as a baseline against which the other alternatives could be compared.

The second phase of the FS process involved the screening of the alternatives listed above which were developed in FS-I. The purpose of FS-II was

to narrow the list of potential alternatives that would be evaluated in detail during the third and final phase of the FS. Three distinct steps were conducted in the alternative screening process. First, the alternatives were evaluated to determine their effectiveness for protecting public health and the environment. Second, the alternatives were evaluated to determine their feasibility. Finally, the alternatives were costed to an accuracy within +100% to -50%.

From the information gathered during the alternative screening process, the Multi-Media Soil Cap and the In-Situ Solidification/Chemical Fixation alternatives were both screened out. Both alternatives have implementation problems because of site conditions. The physical requirements for finishing the edge of the cap could not be met with the electrical substation bordering the area and both the cap and the in-situ solidification alternative would make it impossible to access the conduits running through the site without destroying the integrity of the alternatives. The remaining five alternatives were carried into FS-III, the detailed analysis.

The third and final phase of the FS process for the PCB Spill Site was the detailed analysis of alternatives. This included a technical analysis, environmental analysis, public health analysis, institutional analysis, and a cost analysis for each of the alternatives. The alternatives were then compared for present worth costs, health information, environmental effects, technical aspects, how well the alternatives meet technical requirements and environmental regulations, and community effects. The results of the detailed analysis can be seen in Table ES-3, which compares all of the alternatives.

RECOMMENDATIONS

This section presents the recommendations and the rationale for placing each of the six AF Plant 85 sites into one of the three categories developed by the Air Force. These categories are defined as follows:

TABLE ES-3
COMPARISON OF ALTERNATIVES

CRITERIA	NO ACTION ALTERNATIVE	PERIMETER FENCING ALTERNATIVE	EXCAVATION/ROTARY KILN CHEMICAL TREATMENT/ BACKFILLING/INCINERATION ALTERNATIVE	EXCAVATION/ROTARY KILN INCINERATION/ BACKFILLING ALTERNATIVE	EXCAVATION/LANDFILLING/BACKFILLING ALTERNATIVE
COST					
Capital Cost	\$0	\$1,000	\$204,700	\$292,100	\$31,200
Annual O&M Cost	\$0	\$0	\$0	\$0	\$0
Present Worth Cost	\$0	\$1,000	\$204,700	\$292,100	\$31,200
HEALTH INFORMATION					
Exposure Pathways Addressed	Does not address contamination in any way.	Slightly reduces risk from direct contact/ingestion by limiting access to the site.	Provides a significant reduction in risk from the direct contact/ingestion and inhalation exposure pathways.	Provides a significant reduction in risk from the direct contact/ingestion and inhalation exposure pathways.	Provides a significant reduction in risk at the site from the direct contact/ingestion and inhalation exposure pathways.
Short-Term Effects	Site conditions unchanged.	Alerts potentially exposed population to site problems.	Slight increase in dust and handling of contaminated soils during excavation and treatment. Thus, health risk is slightly increased for a short time.	Slight increase in dust and handling of contaminated soils during excavation and treatment. Thus, health risk is slightly increased for a short time.	Slight increase in dust and handling of contaminated soils during excavation, which will slightly increase health risks.
Time Until Protection is Achieved	Not Applicable	Fence installed in less than a week to reduce access to site.	The excavation and treatment could be completed in less than a month.	The excavation and treatment could be completed within a week.	The excavation and landfilling can be completed within a week.
Long-Term Effects	Area of contamination will slowly increase while concentrations will slowly decrease. All exposure pathways and risks remain.	Area of contamination will slowly increase while concentrations will slowly decrease. All exposure pathways and risks remain.	The contaminant levels are reduced to 1/28th of those under the no-action alternative, thus significantly reducing the health risk posed by the PCBs. Only a slight but acceptable risk remains at the site.	The contaminant levels are reduced to 1/28th of those under the no-action alternative, thus significantly reducing the health risk posed by the PCBs. Only a slight but acceptable risk remains at the site.	The contaminant levels are reduced to 1/28th of those currently at the site, thus significantly reducing the health risks at the site. Overall there is only a moderate risk reduction. There will be risks present at the landfill.
ENVIRONMENTAL EFFECTS					
Beneficial Effects	None	None	Removes PCBs from the environment and permanently destroys them.	Removes PCBs from the environment and permanently destroys them.	Removes PCBs from the site.
Adverse Effects	Contaminants will continue to slowly migrate and increase the volume of contaminated soil.	Contaminants will continue to slowly migrate and increase the volume of contaminated soil.	Excavation of PCB-contaminated soil may temporarily release PCBs into the atmosphere. There is the possibility of a spill from the on-site treatment process.	Excavation of PCB-contaminated soil may temporarily release PCBs into the atmosphere.	Excavation may temporarily release PCBs into the atmosphere. No reduction in toxicity or mobility. Risks are transferred to the landfill.
TECHNICAL ASPECTS					
Performance	NA	Effective in limiting access to the contaminated area. Effective in alerting the potentially exposed population to the PCB problem.	Effective in removing PCBs from site. Effective in destroying PCBs. Feasibility study required.	Effective in removing PCBs from site. Effective in destroying PCBs.	Effective in removing PCBs from site. Effective in reducing mobility of PCBs.
ARAR Compliance					
- Chemical Specific	Does not meet the 40CFR761, PCB-spill cleanup policy requiring cleanup to 25 mg/kg.	Does not meet the 40CFR761, PCB-spill cleanup policy requiring cleanup to 25 mg/kg.	Will meet the 40CFR761, PCB-spill cleanup policy requiring cleanup to 25 mg/kg.	Will meet the 40CFR761, PCB-spill cleanup policy requiring cleanup to 25 mg/kg.	Will meet the 40CFR761, PCB-spill cleanup policy requiring cleanup to 25 mg/kg at the site.
- Location Specific	There are no location-specific ARARs.	There are no location-specific ARARs.	There are no location-specific ARARs.	There are no location-specific ARARs.	There are no location-specific ARARs.
- Action Specific	Would not meet any ARARs since there is no action.	There are no ARARs for constructing a fence.	Would meet requirements for excavation, treatment, and incineration.	Would meet requirements for excavation, incineration, and transportation of hazardous waste.	Would meet requirements for excavation and landfilling.
Special Site or Waste Conditions	None	None	Excavation will be complicated by presence of underground conduits running through the site.	Excavation will be complicated by presence of underground conduits running through the site.	Excavation will be complicated by presence of underground conduits running through the site.
Operation, Maintenance and Monitoring Requirements	None	None	The KPEG process will require the use of special equipment and trained operators.	No special operation, maintenance, or monitoring required.	No special operation, maintenance, or monitoring required.
Off-Site Facilities	None	None	The waste from the chemical treatment is incinerated. The waste is handled by the process contractors.	EMSCO rotary kiln incinerator, Eldorado, Arkansas	Chemical Waste Management Landfill, Emelle, Alabama
Result of Alternative	Current site conditions remain. The mobility, toxicity, and volume of contaminants remain unchanged. All risks remain.	The mobility, toxicity, and volume are unchanged. Access is limited to the site. All risks remain.	Soil with PCB concentrations at or above 25 mg/kg is removed and treated. The mobility, toxicity, and volume of contaminants are significantly reduced. A slight but acceptable risk remains at the site.	Soil with PCB concentrations at or above 25 mg/kg is removed and treated. The mobility, toxicity, and volume of contaminants are significantly reduced. A slight but acceptable risk remains at the site.	Soil with PCB concentrations at or above 25 mg/kg is removed from the site and landfilled. Only mobility of the contaminants is reduced by landfilling. A slight but acceptable risk will remain at the site. An added risk will be created at the landfill.
Safety Requirements	NA	Dust masks or respirators required by workers during fence installation.	Protective clothing and respirators will be required for workers to prevent direct contact with and inhalation of contaminants. Safe operating practices will be followed for the KPEG process.	Protective clothing and respirators will be required for workers to prevent direct contact with and inhalation of contaminants. All regulations for transporting hazardous waste will be followed.	Protective clothing and respirators will be required for workers to prevent direct contact with and inhalation of contaminants.
COMMUNITY EFFECTS					
Community Protection	Risk to community is not increased by alternative but all present risks to community still exist.	Risk to community is not increased by alternative. Present risk at site is only slightly reduced.	Risk to the community is slightly increased during the alternative implementation. Overall, risks are significantly reduced to an acceptable level.	Risk to the community is slightly increased during the alternative implementation. Overall, risks are significantly reduced to an acceptable level.	Risks to the community are slightly increased during the implementation of the alternative. Overall, the risks are significantly reduced at the site but will be increased at the landfill.

1. Category 1: Sites and/or operable units where no further IRP action (including remedial action) is required. Existing data for these sites are considered sufficient to determine no significant impact on human health or the environment.
2. Category 2: Sites and/or operable units requiring additional IRP effort to 1) determine the MTV of detected contaminants, 2) evaluate human health and environmental risks associated with each contaminant, and 3) conduct the detailed evaluation of remedial alternatives.
3. Category 3: Sites and/or operable units where the Feasibility Study process has been completed (i.e., selection of remedial alternative).

Recommendations were developed based on information gathered during IRP Phase 1; Phase 2, Stage 1; and RI/FS, Stage 2 investigations of the six Plant 85 sites. The PCB Spill Site was the only site to be placed into Category 3 and will be discussed first. The Fire Department Training Area has been designated as a Category 2 site and will be discussed second. The remaining sites (Mason's Run, James Road Hazardous Waste Storage Area, Turkey Run, and the Perimeter Wells) have all been classified as Category 1.

Recommendations and Rationale for Category 3 Site: PCB Spill Site (Site 3)

Investigation of Site 3 revealed PCB concentrations in the soil as high as 700 mg/kg. The complete extent of contamination is still unknown but it is estimated that approximately 60 cubic yards of soil are contaminated. This site was characterized as a Category 3 site and a Feasibility Study was conducted. A summary and comparison of the results from the detailed analysis can be seen in Table ES-3. The recommendations based upon this study are discussed below.

From the information obtained during the Feasibility Study, two possible alternatives emerged for the recommended action at Site 3: the Excavation/KPEG Chemical Treatment/Backfilling/Incineration Alternative, which represents the current legislative preference in SARA for treatment and destruction of contaminants, and the Excavation/Landfilling/Backfilling Alternative, which represents the more traditional alternative under CERCLA for the conditions at

this site. Both of these alternatives would have similar beneficial on-site results.

The Excavation/KPEG Chemical Treatment/Backfilling/Incineration Alternative and the Excavation/Landfilling/Backfilling Alternative both would produce the desired results at the site. They would meet the ARARs, are technically implementable, and are proven effective at the scale of this IRP site. The advantage of the chemical treatment alternative is that it would destroy the majority of the PCBs. The advantage of the landfilling alternative is its low cost (\$31,200 as compared to \$204,700 for chemical treatment) and simplicity.

Based on the above information, the Excavation/Landfilling/Backfilling Alternative is recommended as the remedial action for Site 3. Despite the fact that use of this alternative would not destroy the PCBs, it would reduce the PCB contamination at the site at considerably less cost. SAIC cannot justify recommending chemical treatment at this time, as it is not the most cost-effective alternative. Perhaps if the costs of this chemical treatment alternative have been reduced by the time the remediation plan is being developed, this alternative could be reconsidered.

Recommendations Rationale for Category 2 Site: Fire Department Training Area (Site 4)

Although a variety of organic compounds were detected in soil and groundwater samples collected from Site 4, none of the concentrations exceeded any regulatory standards.

TCE and some of its breakdown products were found in soil samples in relatively low concentrations, none exceeding established standards or guidelines. The one exception to this is the 189 mg/kg concentration of TCE found in soil sample S0403 at a depth between 7.5 and 9.0 feet. Although confirmed in second-column analysis, this Stage 1 value may be suspect due to the low concentration found in its duplicate (1.3 mg/kg, unconfirmed). However, assuming that this high value was valid, the health risk from this compound was examined. TCE has a high water solubility, yet it was not

detected in the groundwater samples collected from the downgradient well monitoring the area of the borehole in which it was found. This is probably due to the very low permeability of the soils in this area. Although TCE is highly volatile, the depth at which this compound was detected indicates that the only risk to health from TCE would occur during excavation at this site.

An argument for no further action could be made for this site unless the property were to be sold. Because of the depth at which the high TCE value was detected, excavation of this soil for a building foundation could volatilize the TCE, allowing it to enter the atmospheric pathway. If no further action were to be taken to investigate the TCE, the Air Force would likely be required to include a deed disclosure, describing the possibility of TCE on the site, in any agreement they might make to sell the property. To avoid the possibility of future liability at this site, the Air Force would benefit from determining further if the TCE is actually present at this site and to what extent.

Recommendations for a Stage 3 investigation include another soil-gas survey, drilling an additional borehole, and collecting more soil samples to identify any soil volume with high TCE values. To avoid duplicating the problems encountered during Stage 1, a Stage 3 soil-gas survey would need to be conducted using more sensitive instrumentation and during a drier season, such as late summer or early fall. The number of boreholes to be drilled and samples to be taken would depend on the results of the soil-gas survey. The area of investigation should be focused in the fire training pit around the collection station for soil sample S0403.

Recommendations Rationale for Category 1 Sites

The following discussions provide the rationale for recommending placement of the remaining sites into Category 1. A Technical Document Supporting No Further Action (TDSNFA) has been prepared for each of three sites; the perimeter wells should not require a TDSNFA as they are not associated with an actual site of waste disposal.

Mason's Run (Site 5). The presence of high concentrations of PAHs, oil and grease, and metals in the sediments in the vicinity of the oil/water separator system and concrete weir indicate that a very small, localized health risk does exist. These contaminants are associated with this system and should be cleaned up as part of the regular maintenance program for the system. The small amount of contaminated sediment, particularly upstream from the concrete weir, should be barreled and properly disposed of as petroleum hydrocarbon products. Because this situation is seen as a maintenance problem, it was determined that the expense of preparing a full-scale Feasibility Study was not warranted.

James Road Hazardous Waste Storage Pad (Site 8). Although a variety of organic compounds were detected in soil and groundwater samples collected from Site 8, none of the concentrations exceeded any regulatory standards.

There does not appear to be a threat to human health or the environment from the presence of PAHs in the one soil sample collected from what is thought to be an old roadbed at JRHWP. These contaminants are of limited areal extent and total PAH concentration did not exceed the tentative Netherlands guidelines which would warrant further investigation of these compounds in soils. Also, they were not detected in groundwater samples collected from monitoring wells at Combined Site 4/8. Since these contaminants are not very soluble in water, and they are highly adsorbent to soil, the likelihood of them entering the groundwater is very low, especially considering the low yield of the water-bearing formation. Finally, the depth at which the PAHs were found is such that the only risk to health would occur if they were excavated. However, even if excavated, there is inadequate evidence that the PAHs found at this site would be carcinogenic in humans or would damage the environment.

Freon 113 was the only contaminant of concern detected in the groundwater; and, it was not detected in any of the soil samples. Although the concentration did exceed the action level established by the state of California, it was detected in a transitional water-bearing zone. This zone is not used as a water supply, nor is it expected to be, due to its low yield.

In addition, this compound is noncarcinogenic with an acceptable oral route intake in chronic situations of 3.0 mg/kg/day, which would allow an average person to ingest 2,100 mg/day. Therefore, there does not appear to be any threat to human health or the environment as a result of past activities at this site.

Turkey Run (Site 10). Despite the high metals concentrations in sediments collected from Turkey Run, it was determined that this site did not pose an apparent threat to human health and the environment. The rationale for this decision is as follows:

1. The metals are apparently bound up in the sediments since concentrations of the same constituents in the surface water are low and do not exceed any primary MCLs, even the more stringent, proposed ones.
2. Although surface waters are the primary source of municipal water supplies in Franklin County, no known supplies are present within 3 miles downstream of the Plant. Although a present threat to human health is not of concern via this pathway, the future use of the larger downstream creeks as a water supply is unknown.
3. Access to the facility is restricted, which eliminates incidental dermal contact with and ingestion of these metals by children and inhalation is highly improbable; therefore, these exposure pathways are not present.
4. According to the Ohio Division of Natural Areas and Preserves, the only endangered or threatened species or critical habitats within 5 miles of the facility are located upstream, to the northeast of Plant 85; therefore, there is no risk to these environmentally sensitive areas from Plant activities around Turkey Run. Further, Turkey Run flows through a very industrialized setting and a healthy natural stream environment could not be achieved unless more than the Plant's 375-foot segment of this low-flowing stream were involved in cleanup activities.
5. With the possible exception of zinc, there is no significant increase in the concentrations of the metals (used for comparison with guidelines) due to Plant activities. Barium and copper increased in concentrations only slightly.
6. No specific federal or state regulatory standards exist for metals in sediments and the criteria used for comparisons are guidelines only.

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1.0 INTRODUCTION

The Environmental Remediation Division of Science Applications International Corporation (SAIC) has prepared the following Remedial Investigation/Feasibility Study (RI/FS) in conjunction with the U.S. Air Force (USAF) Installation Restoration Program (IRP) of environmental study and remediation. This RI/FS report summarizes the results of research on the Air Force (AF) Plant 85, Columbus, Ohio (Figure 1-1) under the IRP, incorporating other appropriate research. The overall intent of this study is to evaluate the existing data to define appropriate remedial actions at the facility.

1.1 U.S. AIR FORCE INSTALLATION RESTORATION PROGRAM

The U.S. Air Force Installation Restoration Program is designed to identify, confirm/quantify, and remediate problems caused by past management of hazardous wastes at Air Force facilities. It is the basis for assessment and response actions on USAF installations, under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

1.1.1 Program Origins

In 1981, Executive Order 12316 directed the military branches to design their own program of compliance with the National Contingency Plan (NCP) established by CERCLA. In response to the order, the Department of Defense (DoD) directed the branches of the Defense Department to identify hazardous waste disposal sites to which they were co-contributors, and to comply with environmental regulations at the installation level when implementing cleanup. DoD developed the basic Installation Restoration Program, from which the Air Force IRP was modeled. The Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5 of 11 December 1981, implemented by the Headquarters of the Air Force in January 1982, set forth the basic authority and objectives for the Air Force program.

The Superfund Amendments and Reauthorization Act of 1986 (SARA) has augmented the scope and requirements of CERCLA and has given specific direc-

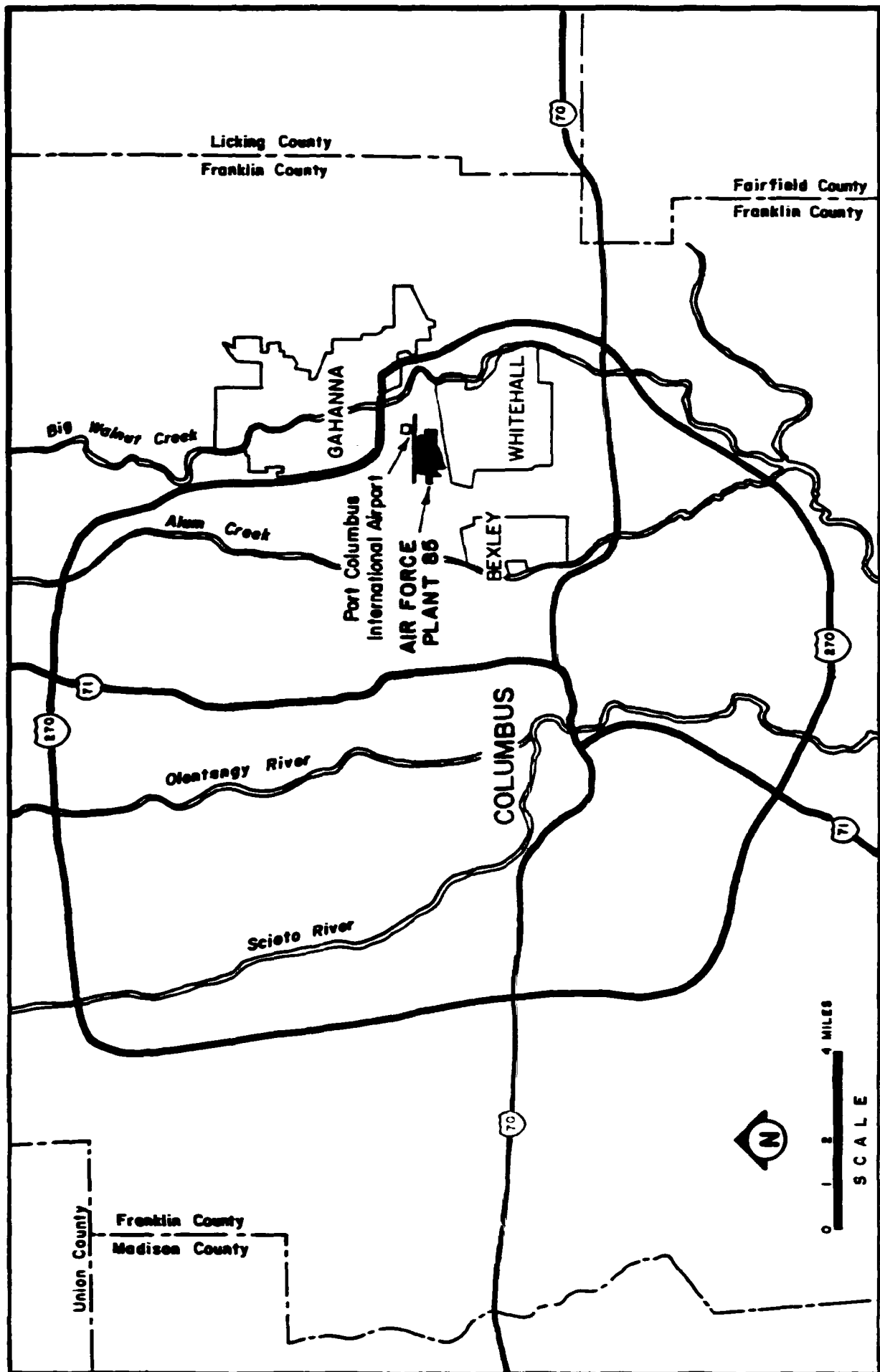


Figure 1-1. Location Map of Air Force Plant 85, Columbus, Ohio.

tives to federal facilities regarding investigation of waste disposal sites. Under SARA, technologies that provide permanent remediation of a contaminant are preferable to action which only contains or isolates the contaminant. SARA also provides for greater interaction with the public and state agencies, and extends the role of the U.S. Environmental Protection Agency (EPA) in evaluation of the health risks associated with the contamination. Under SARA, early determination of the Applicable or Relevant and Appropriate Requirements (ARARs) is required, and potential remediation alternatives should be considered at the initiation of an RI/FS.

To respond to the changes in the NCP brought about by SARA, the IRP was modified in November 1986 to provide for an RI/FS program to improve continuity in the site investigation and remedial planning process for Air Force installations. In July 1987, Executive Order 12580 was signed, delegating responsibility to conduct site investigations and cleanups at federal facilities to the secretaries of various agencies. This order defined relationships between various federal and state agencies, and provided EPA with a role as a facilitator in dispute resolutions.

1.1.2 Program Objectives

The objectives of the Air Force IRP are to assess past hazardous waste disposal and spill sites on Air Force installations, and to develop remedial actions consistent with the NCP for those sites which pose a threat to human health and welfare, or to the environment. The intent is to conduct the RI and FS in parallel, in accordance with CERCLA and SARA, instead of in serial fashion.

In order to meet these overall objectives, specific program objectives must be met:

1. A reliable database must be developed through good field practice and rigorous analytical procedures.
2. A Quality Assurance/Quality Control (QA/QC) program must be developed and implemented to assure the production of meaningful and defensible data.

3. A site Health and Safety Plan must be developed and followed to protect personnel and to prevent the release of, or exposure to, any contaminants.
4. A rigorous procedure must be utilized to characterize wastes and waste sources, to evaluate potential pathways for contaminant migration, and to identify human and environmental targets in order to assess health and environmental risks and to compare remedial alternatives and select an appropriate remedy.
5. Data gaps must be identified, and appropriate additional or supplemental studies must be recommended and executed during the course of performing the program. This includes additional field and/or analytical data collection as well as the evaluation of candidate technologies.
6. The program must be conducted in compliance with appropriate federal regulations and available guidance.
7. The public and regulatory agencies must be informed regarding the nature of the contamination, the effects upon the community, the progress of the program, and the preferred remedial alternative and its impacts.

1.1.3 Program Organization

Prior to 1988, the basic USAF IRP was a program comprised of four phases:

1. Phase I - Installation Assessment/Records Search. This phase identified past disposal sites that might pose a hazard to public health or the environment. It also determined those sites requiring further action, such as confirming an environmental hazard (Phase II). If a site required immediate remedial action, the program could proceed directly to Phase IV.
2. Phase II - Confirmation/Quantification. This phase defined and quantified the extent of contamination, waste characteristics (when required by the regulatory agency), and sites or locations where remedial actions were required. Stage 1 of Phase II was an initial assessment to determine if contamination was present at a site. Sites found to be contaminated might require further investigation in subsequent stages of Phase II to assess the extent and significance of contamination. Sites warranting immediate remedial action could be transferred to Phase IV. Research requirements identified during Phase II were included in the Phase III effort of the program.

3. Phase III - Technology-Based Development. This phase developed new technologies for treating pollutants which have no currently available, or economically feasible, treatment. This phase included implementation of research requirements and technology development. A Phase III requirement could be identified at any time during the program.
4. Phase IV - Remedial Action. This phase involved the preparation and implementation of the remedial action plan.

In 1988, the phased approach of the IRP was superseded by an approach more closely approximating the RI/FS format used by the U.S. EPA. The new IRP format combines the Phase II, Confirmation/Quantification Study, and the Phase IVa, Remedial Action Planning, as outlined under the older version of the IRP to efficiently arrive at appropriate remedial actions in a timely manner.

Potential sites of concern are first identified through a preliminary assessment, including a literature/records search. In general, a Defense Priority Model is now being used for ranking Air Force sites, although previously a Hazard Assessment Ranking Methodology (HARM) score was assigned to each site identified, based on contaminants generated, stored, and disposed of, and where such activities were conducted. If a release is suspected, an initial sampling and analytical program is recommended to identify target contaminants and confirm their presence. When a preliminary assessment has been completed, either an RI/FS program is recommended to further evaluate the site, or a Technical Document to Support No Further Action (TDSNFA) is prepared.

A remedial investigation is conducted in stages to collect information on the type and extent of contamination in the environment through field sampling. The results are evaluated in terms of public health and environmental criteria. A feasibility study, in which remedial alternatives are identified and ultimately recommended for selection, is conducted somewhat in parallel with the remedial investigation so that field data needed to select a remedy are collected during the field investigation.

The RI/FS is intended systematically to:

- o Identify and prioritize contamination sources with respect to hazard
- o Determine the nature and extent of contamination, or conclude that no significant adverse impact exists
- o Determine the pathways and risks of the identified contamination to various human and environmental receptors
- o Plan and conduct field activities that will support the selection and eventual design of appropriate remedial actions
- o Develop appropriate remedial alternatives.

The RI/FS program involves a preliminary sampling and analysis effort leading to the development of alternatives. If necessary, a more detailed sampling and analytical effort will be conducted to delineate contamination, and quantify pathways to aid in the selection of alternatives. The RI/FS of the IRP encompasses several key elements necessary to select an appropriate remedial action. These include:

- o Determination of the federal and state ARARs
- o Development of the Data Quality Objectives (DQOs) necessary to be consistent with the ARARs and achievable with acceptable field and analytical procedures
- o Performance of a field investigation in one or more stages to collect sufficient information to assess contaminant movement and pathways, and to support development of potential alternatives; described in CERCLA and NCP as the Remedial Investigation (RI)
- o Determination of the hazards by quantifiably considering the impact on receptors through the pathways of surface water, groundwater, biota, and air; RI/FS incorporates the exposure and risk assessment as required under CERCLA, NCP, and SARA, and as defined in the Superfund Public Health Evaluation Manual
- o Determination of those sites where the results of the field investigation and risk assessment indicate no significant threat to human health or welfare, or to the environment, and preparation of a decision document identifying any necessary control measures, or no need for further action
- o Development of a set of potential alternatives, consisting of appropriate technologies that can remove the contamination or

control its migration; alternatives should provide a range of reduction of the mobility, toxicity, or volume (MTV) associated with the contamination, and meet or exceed the ARARs.

Initial screening of alternatives is conducted using criteria of effectiveness, implementability, and cost. If necessary, additional studies are performed to support selection of technologies. A detailed analysis is then conducted to evaluate alternatives using a set of criteria that includes protectiveness, compliance with ARARs, reduction of MTV, schedule, reliability, and capital and operation and maintenance cost.

After a remedial alternative is selected, a Record of Decision (ROD) is created, which documents the selection based on information and recommendations contained in the IRP Final Technical Report. If an engineering solution is selected, the remedial design is specified and then implemented.

The IRP meets the requirements of the NCP in that an investigation is conducted to characterize contaminant sources and migration, to assess risk to human health and the environment, and to evaluate and recommend remedial actions.

1.2 PURPOSE AND SCOPE OF PRESENT INVESTIGATION

SAIC and its subcontractor, Brown and Caldwell Laboratories, were contracted by the U.S. Air Force Occupational and Environmental Health Laboratory (HSD/YAQI) to conduct an IRP RI/FS, investigation at AF Plant 85 in Columbus, Ohio. The investigation was undertaken: 1) to determine whether any contamination existed at six sites of interest; 2) if possible, to determine the magnitude of any contamination and its potential for migration; 3) to identify significant public health and environmental hazards of migrating contaminants, based on federal and Ohio standards; and 4) to develop and recommend alternative remedial actions.

Phase II, Stage 1 field investigations were conducted from 12 December 1985 to 16 January 1986; those for Stage 2 began on 19 September 1988 and were completed on 16 December 1988.

Sites were selected from the Phase I investigation performed by CH2M HILL, the Phase II, Stage 1 investigation performed by PEI and Battelle-Columbus Division, and the Stage 2 Pre-survey performed by Battelle Denver (SAIC) and HSD/YAQI.

During this field investigation, soil, sediment, surface water, and groundwater samples were collected at the following sites (see Figure 1-2):

- o PCB Spill Site (Site 3)
- o Fire Department Training Area (Site 4)
- o Mason's Run Oil/Fuel Spill (Site 5)
- o James Road Hazardous Waste Storage Pad (Site 8)
- o Turkey Run (Site 10)
- o Perimeter Monitoring Wells.

The collected samples were analyzed in the field and in the laboratory to identify the presence and magnitude of several potentially hazardous contaminants. Site 10 (Turkey Run) and Perimeter Monitoring Wells were added for the RI/FS, Stage 2 investigations.

The investigation was conducted under Contract No. F33615-85-D-4507, Task 21 with the U.S. Air Force and in accordance with the Scope of Work (SOW) contained in Appendix B. The SOW defined sampling and testing procedures to be followed, the number of samples to be collected, the analyses to be performed, and the analytical methods to be used.

In the Phase I report (CH2M HILL, 1984), one additional site was recommended for investigation during the Phase II investigation. The Coal Pile (Site 2), located near the old boilerhouse, received an overall HARM rating of 51 due to the potential of contamination to groundwater and soils from the coal dust remaining on site. However, analysis of groundwater and soil samples

collected at and downgradient of this site during the Phase II, Stage 1 investigation indicated that the Coal Pile was not contributing contaminants to those environmental media. Subsequently, a TDSNFA was written on Site 2 at the conclusion of Stage 1.

1.3 HISTORY OF PLANT 85 AND WASTE DISPOSAL AND STORAGE PRACTICES

1.3.1 Plant 85 History

Completed in 1941, AF Plant 85 produced naval aircraft during World War II under contract with the Curtiss-Wright Corporation. The Plant employed 24,000 people and produced 3,500 airplanes. Production declined after the war and Curtiss-Wright discontinued operations in 1950.

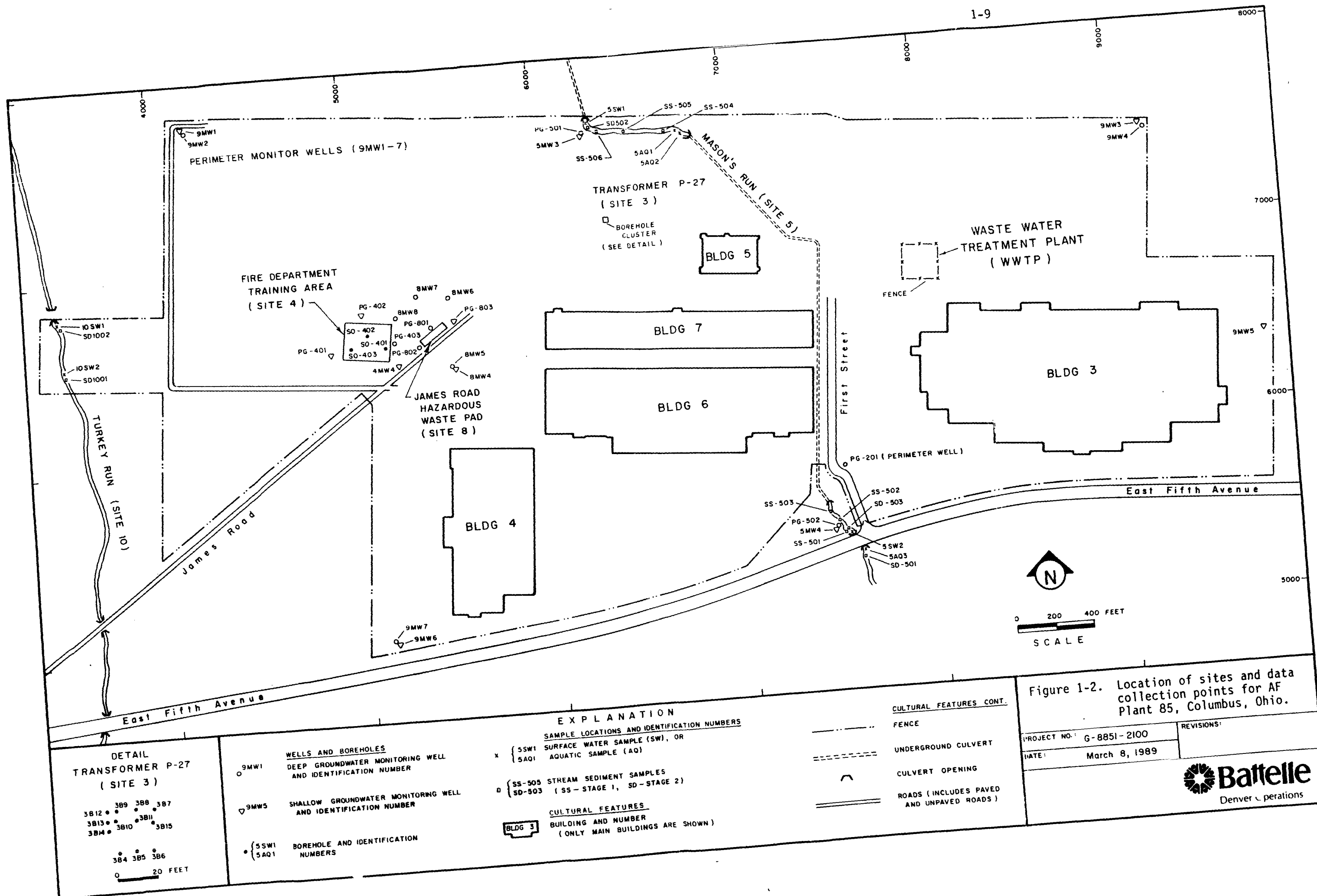
In late 1950, the U.S. Navy took over the title of the Plant, which became the Naval Industrial Reserve Aircraft Plant (NIRAP) Columbus. At that time, North American Aviation (now Rockwell International) took over Plant operations. Numerous kinds of naval aircraft and missile systems were produced and tested over the next several years. Aircraft production declined in the 1970s and by 1979 only 2,000 employees remained at the Plant.

In 1982, NIRAP Columbus was transferred to the U.S. Air Force from the Navy and designated AF Plant 85; Rockwell International was awarded the contract for the production of the B-1B bomber aircraft.

In 1988, after the completion of Phase II, Stage 1 field investigations, roughly one square mile of land, located in the western portion of AF Plant 85, was given back to the city of Columbus. During December 1988, McDonnell Douglas took over operation of AF Plant 85 from Rockwell. Their plans for the site presently include the manufacture of aircraft parts.

1.3.2 Waste Disposal and Storage

The AF Plant Representative's Office (AFPRO) is the host of AF Plant 85. The staff is responsible for contract administration, manufacturing opera-



tions, quality control functions, environmental programs, and general administrative duties.

Various waste-handling operations have occurred since 1941. The Fire Department Training Area (FDTA, Site 4) had been used as a primary disposal site. Between 1941 and 1950, most of the waste oils, solvents, and aviation fuels produced were collected and burned at the FDTA. Fire Department personnel collected waste oil drums from the various accumulation points, transported them to the training area, and subsequently poured the waste fuels on the ground and ignited them. Between 1951 and 1965, some waste engine oils and fuels were still used in Fire Department training exercises; however, the majority of the waste oils were collected and sold to an outside contractor for off-site disposal.

The storm water drainage system which emptied into Mason's Run received paint solvents and chips from activities occurring at a concrete pad located outside and to the north of Building 3 between 1941 and 1950.

Concentrated acid solutions from metal cleaning, etching, and electroplating tanks were collected and transported to a neutralization tank that was located near the present wastewater treatment plant (WWTP). The solutions were batch-neutralized and then discharged to the sanitary sewer for further treatment by the city of Columbus. Overflow from the process rinse-water tanks was also discharged to the sanitary sewer. Sludges from these process tanks were drummed and moved off site by an outside contractor.

In 1965, the WWTP was constructed to neutralize all industrial process wastewaters prior to their discharge to the sanitary sewer. The majority of the Plant's industrial wastewater flow has come from the rinse-water overflow tanks of the various metals cleaning, etching, and electroplating processes. Metal processing tanks containing chromium solutions are currently transported to the WWTP in 500-gallon tank cars. Hexavalent chromium solutions are reduced to the trivalent state with sulfur dioxide and then discharged to the sanitary sewer. Cyanide waste was transported to a cyanide storage tank, located at the WWTP, and subsequently hauled off site by an outside contractor. However, this

tank was relocated to the James Road Hazardous Waste Storage Pad (JRHWP) in 1984 and has not been utilized since then. Cyanide waste was stored at the JRHWP in DOT-approved 55-gallon steel drums with heavy plastic liners (Hargis + Associates, Inc., 1989). Lime sludges generated at the WWTP are dewatered, collected in runoff bulk containers, and hauled off site for disposal.

Spent degreasing solutions [1,1,1-trichloroethane (TCA)] were collected in 55-gallon drums and stored at the James Road Hazardous Waste Storage Pad until they were transported off site for redistillation of the TCA (Hargis + Associates, Inc., 1989). The IRP records search for AF Plant 85 researched and produced by CH2M HILL in 1984 provided the waste disposal and storage information. Acetone and methyl ethyl ketones (MEK) were also stored at this pad and subsequently transported off site by contractors. The James Road Hazardous Waste Storage Pad is no longer used; the Air Force and Rockwell are presently in the process of officially closing this RCRA-permitted storage pad.

Methylene chloride/phenolic paint strippers, used in the Building 13 stripping shop, are collected in drip pans and then poured in 55-gallon drums; contractors dispose of these drums off site.

Table 1-1 summarizes the major industrial operations at the Plant and includes the estimated quantities of wastes generated as well as providing the past and present disposal practices.

1.4 DESCRIPTION AND HISTORY OF INDIVIDUAL SITES

The Phase I IRP recommended three sites for environmental sampling: Mason's Run Oil/Fuel Spill Site (Site 5), Fire Department Training Area (Site 4), and James Road Hazardous Waste Storage Pad (Site 8). In addition to these sites, the PCB Spill Site (Site 3) has been included in this IRP investigation to provide additional information on the adequacy of cleanup already conducted. As a result of the Stage 2 Pre-survey, Site 10 (Turkey Run) and the Perimeter Monitoring Wells were added to the IRP RI/FS, Stage 2 investigation. Brief site descriptions are provided in the following subsections. Figure 1-2 shows the location of all six sites and data collection points for this investigation.

Table 1-1
MAJOR INDUSTRIAL OPERATIONS SUMMARY

Shop Name/Department	Present Location (Bldg. No.)	Waste Material	Current Estimated Waste Quantity (gal/yr)	Past and Present Waste Management				
				1940	1950	1960	1970	1980
Detail Paint Shop (804)	3	Paint Sludge	73,000 ^a	-----	Sanitary Sewer	-----	Contractor Removal	-----
		Alkaline Cleaner	5,230	-----	Treated at WWTp ^b	-----	-----	-----
		Nitric Acid and Ammonium Bilsulfide	2,520	-----	Treated at WWTp ^b	-----	-----	-----
Aluminum Processing (804)	3	Chromic Acid	6,600	-----	Contractor Removal	Treated at WWTp ^b	-----	-----
		Nitric Acid	3,360	-----	Treated at WWTp ^b	-----	-----	-----
		Sodium Dichromate	12,000	-----	Contractor Removal	Treated at WWTp ^b	-----	-----
		Cyanide/Nitric Acid/Chromic Salt	6,200	-----	Contractor Removal	-----	-----	-----
		Acid Etch	8,800	-----	-----	Treated at WWTp ^b	-----	-----
		Alkaline Etch	14,000	-----	-----	Treated at WWTp ^b	-----	-----

1-13

^aWaste has been shown to be non-hazardous based on the results of EP toxicity tests.

^bTreated effluents from plant are discharged to the sanitary sewer. Prior to 1965, wastes were batch-neutralized prior to discharge to the sanitary sewer.

LEGEND

- - - Assumed period of operation.
- Known period of operation.

Table 1-1 (cont.)

Shop Name/Department	Present Location (Bldg. No.)	Waste Material	Current Estimated Waste Quantity (gal/yr)	Past and Present Waste Management			
				1960	1960	1970	1980
Vapor Degreasing (804)	3	1,1,1-Trichloroethane	780		Contractor Removal		
Electroplating (804)	3	Acid Pickle Solution	540		Treated at WHTP ^b		
		Chromium Plating Solution	670		Contractor Removal	Treated at WHTP ^b	
		Chromic Acid Reversing Solution	325		Contractor Removal	Treated at WHTP ^b	
		Chromic Acid and Sodium Cyanide	2,100		Contractor Removal		
Resistance Welding (826)	3	Alkaline Cleaner	200		Treated at WHTP ^b		
		Cyanide and Chromium Salt Solution	200		Contractor Removal		
Honeycomb Boreing (826)	3	Alkaline Cleaner	960		Treated at WHTP ^b		
		Alkaline Etch	960		Treated at WHTP ^b		

^aWaste has been shown to be non-hazardous based on the results of EP toxicity tests.

^bTreated effluents from plant are discharged to the sanitary sewer. Prior to 1965, wastes were batch-neutralized prior to discharge to the sanitary sewer.

LEGEND

- - - Assumed period of operation.
 _____ Known period of operation.

Table 1-1 (cont.)

Shop Name/Department	Present Location (Bldg. No.)	Waste Material	Current Estimated Waste Quantity (gal/yr)	Past and Present Waste Management				
				1940	1950	1960	1970	1980
Foundry and Plastics Manufacturing (803)	3	Dichromate and Sulfuric Acid Etch	1,600		Contractor Removal		Treated at HWTP	
		Acetone	1,600			Contractor Removal		
		Coolant Oils	24,000 ^a				Contractor Removal	
Stripping Shop (804)	13	Methylene Chloride/Phenolic Strippers	2,860	Stormwater Drainage System		Drummed and Removed Offsite		
HWTP	HWTP	Devatered Lime Sludge	340 ^c				Contractor Removal	
All Machine Milling Shops	General Plant	Milling Coolant Oils ^a	66,000				Contractor Removal	

1-15

^aWaste has been shown to be non-hazardous based on the results of EP toxicity tests.

^bTreated effluents from plant are discharged to the sanitary sewer. Prior to 1965, wastes were batch-neutralized prior to discharge to the sanitary sewer.

^cNet tons per year.

- - - Assumed period of operation.

Known period of operation.

Source: CH2M HILL, 1984.

1.4.1 Mason's Run Oil/Fuel Spill Site (Site 5)

Much of Mason's Run is channeled within an underground concrete culvert throughout the Plant (Figure 1-2). The stream enters the Plant area along the northern boundary (after passage through Port Columbus International Airport property) and exits the Plant in an open ditch near the Plant entrance gate located at the intersection of First Street and Fifth Avenue. Approximately 15 years ago an oil skimmer system and a concrete weir were installed near the Plant's southern boundary just upstream from where Mason's Run flows beneath Fifth Avenue. This stream has received miscellaneous oil and fuel from storm drains since 1941. In May 1983, Mason's Run also received approximately 50,000 gallons of coal-pile leachate as the result of a leak in the coal pile leachate holding tank. The coal pile, which is no longer in use, was located approximately 50 feet from an underground portion of Mason's Run and approximately 300 feet upstream from the open ditch. Indirect evidence of contamination, such as an oil sheen on the water surface and several fish kills have been reported in Mason's Run beyond the Plant boundaries. A school of small fish was seen in Mason's Run below the oil skimmer during the RI/FS, Stage 1 Pre-survey.

The Phase II, Stage 1 investigations consisted of soil, sediment, surface water, and groundwater sampling. The detection of high concentrations of compounds in downstream samples initiated further investigation in Stage 2.

1.4.2 Fire Department Training Area (Site 4)

Fire Department training activities were conducted in the Fire Department Training Area (FDTA; Site 4) at AF Plant 85 from 1941 through 1977. Until 1970, at least one training exercise was conducted per month, after which their frequency slowly decreased to zero by 1977. As many as four fires were extinguished per session, with a total of approximately 900 gallons of fuel consumed per session. These fuels consisted of waste magnesium chips, waste oils, and contaminated aircraft fuel. From 1970 until operations ceased in 1977, aqueous film-forming foam (AFFF) was used to extinguish fires. AFFFs are non-corrosive, biodegradable, fluorocarbon surfactants with foamy stabilizers, which pose a potential for environmental stress. When this training area was

deactivated in 1977, the soil was excavated to a depth of approximately 30 inches and the area was backfilled with clean dirt. The soil left in place was not sampled nor analyzed.

Phase II, Stage 1 investigations included soil and groundwater sampling. Elevated concentrations of purgeable organics were found in soils, but not in groundwater. Determination of the extent of contamination in the soil required confirmation. This was done in the RI/FS, Stage 2 investigation.

1.4.3 James Road Hazardous Waste Storage Pad (Site 8)

From 1941 until 1989, the James Road Hazardous Waste Storage Pad had been used to store drums of hazardous wastes (Figure 1-2). These wastes included 1,1,1-trichloroethane (TCA), acetone, mixtures of other solvents, and phenolic paint strippers. Several spills had occurred on the ground adjacent to the concrete pad currently in place at this site.

Phase II, Stage 1 investigations included soil and groundwater sampling. Purgeable organics were identified in soil samples and elevated levels of total halogenated compounds were detected in one groundwater sample. The identification of the compounds found in groundwater was a target of the RI/FS, Stage 2 investigations, as well as determination of any migration of the compounds in groundwater.

1.4.4 PCB Spill Site (Site 3)

In January 1983, several gallons of transformer oil containing PCBs were spilled at this site. The spill occurred adjacent to Electric Substation 23 (Figure 1-2). The site was excavated twice by Plant personnel. On the first occasion, an area 3 feet wide by 12 feet long by 3 inches deep was excavated. The excavated earth was treated as a hazardous waste and hauled off site. The second excavation expanded the area of removed soil by 2 feet in width and 6 inches in depth. Additional testing was required to determine the adequacy of these cleanup attempts.

Phase II, Stage 1 investigations consisted of soil sampling. Concentrations of PCBs were found which exceeded action levels set by 40 CFR 761, Toxic Substance Control Act (TSCA). Stage 2 investigations were aimed at defining the areal and vertical extent of the PCB contamination.

1.4.5 Turkey Run (Site 10)

Approximately 375 feet of Turkey Run crosses AF Plant 85 on the westernmost segment of land after passage through the Port of Columbus International Airport (Figure 1-2). This site was established during RI/FS, Stage 2 to monitor sediment and surface water quality at both the upstream and downstream boundaries of the site.

1.4.6 Perimeter Monitoring Wells

Perimeter monitoring wells were installed to measure groundwater quality to determine the effects of Plant activities on groundwater. For sampling purposes, the perimeter monitoring wells were given the field designations of 9MW1 through 9MW7 (Figure 1-2). This "site" was established during RI/FS, Stage 2 to monitor the quality of the groundwater as it flows beneath the Plant boundary, under the facility, and as it exits the property. Wells were placed along the perimeter of the Plant. Also included in the Plant-wide monitoring system was Phase II, Stage 1 well PG201.

1.5 KNOWN AND SUSPECTED CONTAMINANTS

Chemical analyses of soil, sediment, groundwater, and surface water samples included some or all of the parameters listed on Table 1-2. All water samples were field measured for alkalinity, pH, specific conductance, and temperature.

1.6 SAIC TEAM ORGANIZATION

RI/FS, Stage 2 investigation of AF Plant 85 was conducted by SAIC and three subcontractors. Figure 1-3 illustrates the organization of the investigation team.

**Table 1-2. Laboratory Analyses Performed on Samples Submitted
from RI/FS Stage 2 Field Investigation at AF Plant 85**

Parameter	Method
Common Anions	E300
Total Dissolved Solids	E160.1
ICP Screen for Metals Total and Dissolved	SW3005/SW6010
Arsenic Total and Dissolved	SW7060
Lead Total and Dissolved	SW3005/SW7421
Mercury Total and Dissolved	SW7470 or SW7471
Selenium Total and Dissolved	SW7740
Purgeable Halocarbons	SW5030/SW8010
Purgeable Aromatics	SW5030/SW8020
Semivolatile Organic Compounds	SW3510/SW8270 or SW3550/SW8270
Volatile Organic Compounds	SW8240
Polychlorinated Biphenyls	SW3550/SW8080
Soil Moisture Content	ASTM D2216
Grain Size Distribution	ASTM 422
Permeability	ASTM D2434

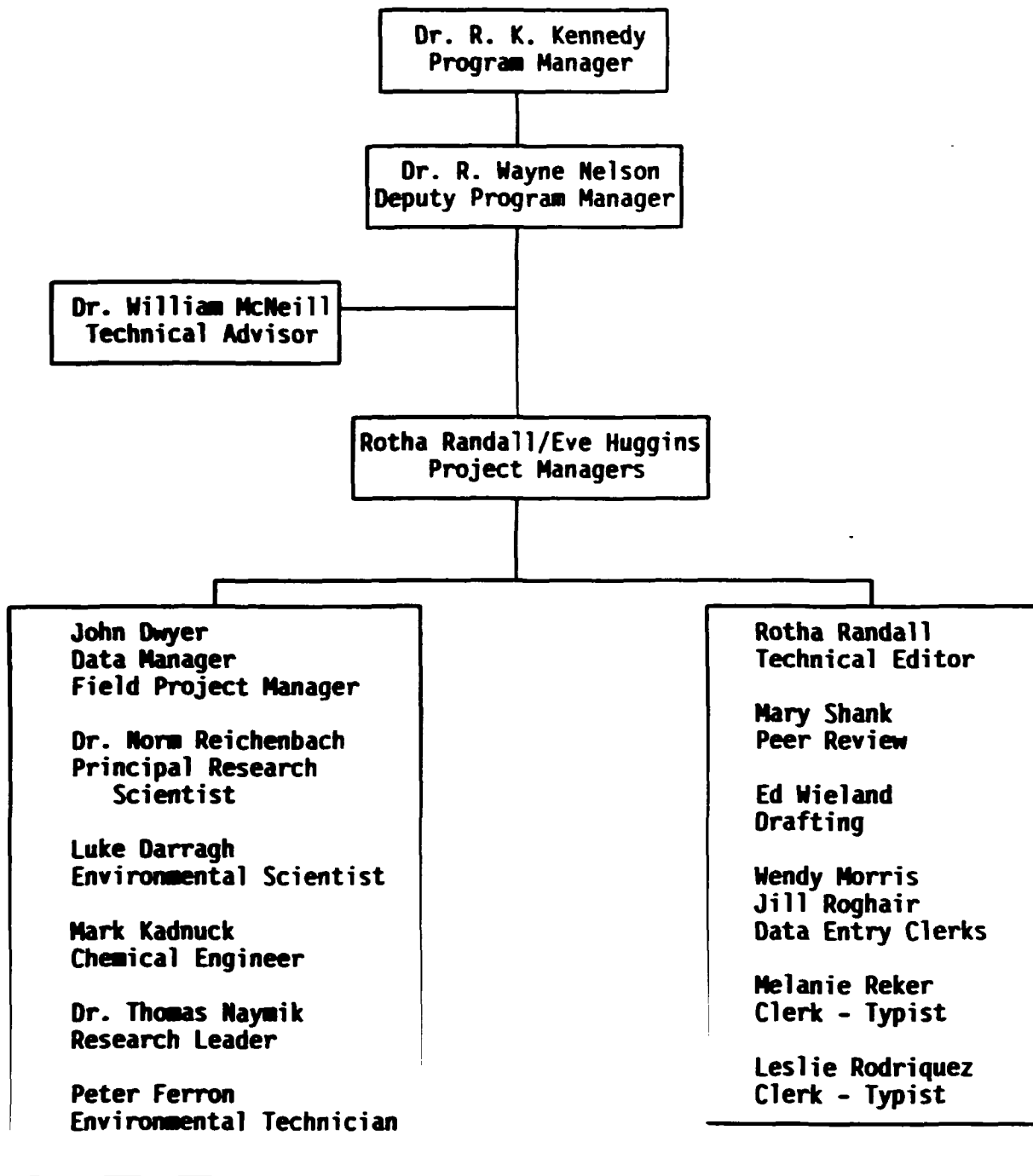


FIGURE 1-3
ORGANIZATIONAL CHART

Program Manager was Dr. Robert K. Kennedy and Deputy Program Manager was Dr. R. Wayne Nelson. Mr. John R. Dwyer acted as Project Manager during field investigation and subsequently as the Data Manager. The field team consisted of Mr. Luke Darragh, Environmental Scientist, and Mr. Pete Ferron, Environmental Technician of Battelle-Columbus Division. Dr. Norman Richenbach, also of Battelle, conducted the aquatic survey. Ms. Rotha Randall, Environmental Scientist, and Ms. Eve Huggins, Environmental Geologist, were the project managers and principal authors, while Mr. Luke Darragh and Mr. Mark Kadnuck assisted with the preparation of the report. Ms. Mary Shank provided a peer review of the report, while the technical review was performed by Dr. William McNeill. Ms. Rotha Randall also edited and produced the report. Ms. Wendy Morris, Ms. Melanie Reker, Ms. Jill Roghair, and Ms. Leslie Rodriguez provided staff support. Mr. Ed Weiland produced graphics for this report. Dr. Tom Naymick from Battelle-Columbus Division Environmental Department assisted in hydrologic data analysis.

The drilling subcontractor was Mason-de Verteuil, who also analyzed selected soil samples for grain size, moisture content, and permeability. Brown and Caldwell Laboratories provided laboratory analytical chemistry; Ms. Linda Brack acted as Brown and Caldwell's Project Manager, for samples submitted during RI/FS, Stage 2. Survey work was performed by John E. Foster Associates.

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2.0 ENVIRONMENTAL SETTING

2.1 GEOGRAPHIC SETTING

2.1.1 Physiography

AF Plant 85 is located in Franklin County in the Central Lowland physiographic province of Ohio (Figure 1-1). Located about 6 miles northeast of downtown Columbus, the Plant is just south of the Port Columbus International Airport. The Plant occupies approximately 300 acres.

The ground surface at the facility is relatively flat, characteristic of the glacial drift which fills paleovalleys in the area. Elevations at the Plant vary from 800 to 815 feet above mean sea level (msl). The only significant relief near the facility occurs in areas adjacent to streams, glacial moraines, or resistant bedrock. The terrain also lacks the numerous lakes and swamps which characterize other glaciated areas.

A series of north-south trending escarpments and terraces separate the central lowlands from the Appalachian Plateau east of Columbus. The lowest of these escarpments rises from an altitude of approximately 800 feet to an altitude of approximately 1,015 feet. Rivers and creeks are controlled by these features and tend to run from north to south.

The principal river in Franklin County is the Scioto River which flows southward through downtown Columbus toward the Ohio River. Tributary streams near AF Plant 85 include Alum Creek and Big Walnut Creek. Big Walnut Creek, located just east of AF Plant 85, is situated near the base of an escarpment, while Alum Creek flows over glacial drift to the west of the Plant.

2.1.2 Cultural Geography

The 1980 population characteristics for the 2-mile radius surrounding the Plant, the city of Columbus, Franklin County, and the Columbus Metropolitan Area are given in Table 2-1. The Columbus Metropolitan area includes Delaware, Fairfield, Madison, Pickaway, and Franklin counties. In addition to the city

Table 2-1

Population Characteristics for Vicinity of AF Plant 85, Columbus, Ohio

CHARACTERISTICS	2-MILE RADIUS	CITY OF COLUMBUS	FRANKLIN COUNTY	COLUMBUS MSA
Total	36,849	564,764	868,751	1,241,333
Female(%)	54.17	51.86	51.80	51.48
White(%)	41.66	76.26	83.54	87.84
Black(%)	56.94	22.11	15.08	11.04
Native American(%)	0.18	0.16	0.14	0.13
Asian(%)	0.35	0.83	0.75	0.59
Hispanic(%)	0.89	0.82	0.75	0.66
Pop. < 10 years old(%)	17.82	14.56	14.56	14.86
Pop. 10 to 19 years old(%)	18.31	16.22	17.10	17.53
Pop. between 20 and 29(%)	18.34	25.39	22.01	20.25
Pop. between 30 and 44(%)	17.26	17.95	19.43	19.90
Pop. between 45 and 59(%)	14.49	13.35	14.53	14.70
Pop. between 60 and 74(%)	9.72	8.99	8.95	9.21
Pop. > 75 years old(%)	4.06	3.54	3.43	3.56

Source: Planning Division analysis, based on 1980 U.S. Census data compiled by Site Evaluation Location System (SELS).

of Columbus, ten other cities and villages lie wholly or partially in Franklin County. The four communities located in the vicinity of AF Plant 85 are Bexley, Gahanna, Reynoldsburg, and Whitehall.

A profile of the demographic characteristics of the residents living within a 2-mile radius of the Plant, and in the city of Columbus, Franklin County, and the Columbus Metropolitan area may be found in Table 2-2.

2.2 GEOLOGY

2.2.1 Geologic Setting

Franklin County is located at the eastern edge of the Central Lowlands physiographic province. Some general characteristics of this province include its great extent, low altitude and slight local relief, continental climate, and great lakes and rivers. The geologic feature that has the greatest influence on Plant 85 is the mantle of glacial deposits. These deposits mask the paleotopography of the broad regional upwarped Paleozoic sedimentary rocks. This upwarp is a regional anticline, known as the Cincinnati Arch, which forms the western flank of the Appalachian geosyncline and the eastern flank of the broad, shallow structural basins under southern Illinois and the Mississippi River Valley. The axis of this arch roughly parallels the Appalachian Highlands and extends 600 miles from northwestern Alabama to northwestern Ohio. North of the Ohio River, the structure of the arch is obscured by glaciation. (Hunt, 1974)

Thus, the geologic sequence in the central Ohio area consists of a sedimentary bedrock overlain by glacial deposits, alluvium, and soil. The geology of the AF Plant 85 area is affected by both preglacial erosion of the bedrock and glacial features. An extensive erosional and drainage system with considerable relief was developed on the bedrock surface prior to glaciation. The main buried channel, known as the preglacial Groveport River, is located in southeastern Franklin County about 9 miles south of AF Plant 85 (Figure 2-1). A major tributary to the preglacial Groveport River flowed beneath the Plant boundaries and then southward to its confluence with the preglacial Groveport

Table 2-2

Population Characteristics of Residents in Vicinity of AF Plant 85, Columbus, Ohio

CHARACTERISTICS	2-MILE RADIUS	CITY OF COLUMBUS	FRANKLIN COUNTY	COLUMBUS MSA
HOUSEHOLD CHARACTERISTICS:				
Total households	13,070	217,150	322,817	449,267
Owner occupied(%)	55.52	48.81	57.02	61.90
Renter occupied(%)	44.48	51.19	42.98	38.10
Rental vacancies(%)	10.53	9.88	9.01	8.49
Owner value specified(\$)	48,162	45,026	53,586	52,465
Renter value specified(\$)	143	174	181	176
Average Monthly mortgage cost(\$)	357	364	400	397
Households with earnings(%)	78.94	82.80	84.41	84.39
Households with a wage or salary income(%)	77.30	81.18	82.49	81.75
Households with non-farm self-emp. income(%)	5.73	6.28	7.83	8.41
Households with farm self-emp. income(%)	0.40	0.61	0.94	2.57
Households with int.,div. or rental income(%)	27.21	38.75	43.61	43.61
Households with social security income(%)	22.98	20.95	2.48	21.57
Households with public asst. income(%)	16.03	9.44	7.47	7.00
Households with all other income(%)	23.59	22.72	23.02	23.57
Avg. annual household wage or salary income(\$)	16,882	17,320	19,543	19,584
Avg. annual household non-farm self-emp income(\$)	18,737	10,527	13,784	13,189
Avg. annual household farm income(\$)	9,115	2,087	3,763	5,318
Avg. annual household int.,div. or rental income(\$)	4,804	1,781	2,290	2,316
Avg. annual household social security income(\$)	3,899	3,882	4,013	4,012
Avg. annual household public asst. income(\$)	2,562	2,456	2,428	2,348
Avg. annual household all other income(\$)	3,959	3,809	4,061	3,842
Households with 1 car(%)	41.10	42.08	38.68	36.28
Households with 2 cars(%)	30.22	31.74	35.76	37.24
Households with 3 or more cars(%)	11.50	11.31	14.05	16.48
FAMILY CHARACTERISTICS:				
Total families	9,365	135,513	218,685	319,214
Married couple families(%)	65.30	74.68	79.21	81.91
Male head of household(%)	4.29	4.31	3.63	3.33
Female head of household(%)	30.41	21.01	17.15	14.75
Families earning < \$ 5,000(%)	14.81	8.80	6.56	6.01
Families earning > \$10,000(%)	68.41	77.96	82.75	83.13
Families earning > \$15,000(%)	54.00	62.39	69.00	69.05
Families earning > \$20,000(%)	39.20	45.88	53.41	53.00
Families earning > \$25,000(%)	27.00	30.97	37.88	36.96

Table 2-2
(Continued)

Population Characteristics of Residents in Vicinity of AF Plant 85, Columbus, Ohio

CHARACTERISTICS	2-MILE RADIUS	CITY OF COLUMBUS	FRANKLIN COUNTY	COLUMBUS MSA
FAMILY CHARACTERISTICS (Cont'd.):				
Families earning > \$30,000(%)	18.64	19.71	25.53	24.39
Families earning > \$40,000(%)	8.38	7.37	11.04	10.21
Families earning > \$50,000(%)	4.13	2.91	5.05	4.61
Families earning > \$75,000(%)	2.02	0.71	1.62	1.42
Average annual family income(\$)	19,765	20,513	23,682	23,193
LABOR FORCE CHARACTERISTICS:				
Total labor force	15,114	261,704	408,420	567,491
Labor force working in county of residence(%)	86.07	85.64	85.23	78.05
Families having 2 or more workers(%)	49.23	55.57	57.58	57.08
Employed in white collar jobs(%)	20.00	24.42	26.42	24.29
Employed in technical and related support(%)	3.11	3.89	3.53	3.38
Employed in sales(%)	7.54	9.69	10.41	10.00
Employed in admin. support including clerical(%)	22.50	22.31	21.56	19.86
Employed in service occupations(%)	18.93	14.00	12.65	12.55
Farming, forestry, & fishing occupations(%)	0.46	0.64	0.67	1.53
Precision production, craft, & repair(%)	9.03	9.64	10.05	11.45
Machine oper., assemblers, & inspec.(%)	9.16	7.23	6.73	8.20
Transportation & material moving(%)	4.61	4.04	4.00	4.44
Handlers, equipment cleaners, helpers etc.(%)	4.66	4.13	3.97	4.30
EDUCATIONAL CHARACTERISTICS:				
	20,159	319,264	498,123	714,804
Elementary(%)	14.62	13.11	11.25	12.18
1-3 years of high school(%)	20.17	17.24	15.32	16.02
4 years of high school(%)	34.28	34.16	35.26	38.17
1-3 years of college(%)	14.78	14.89	15.63	14.27
4 or more years of college(%)	14.93	18.14	20.85	18.04

Source: Planning Division analysis, based on 1980 U.S. Census data compiled by Site Evaluation Location System (SELS).

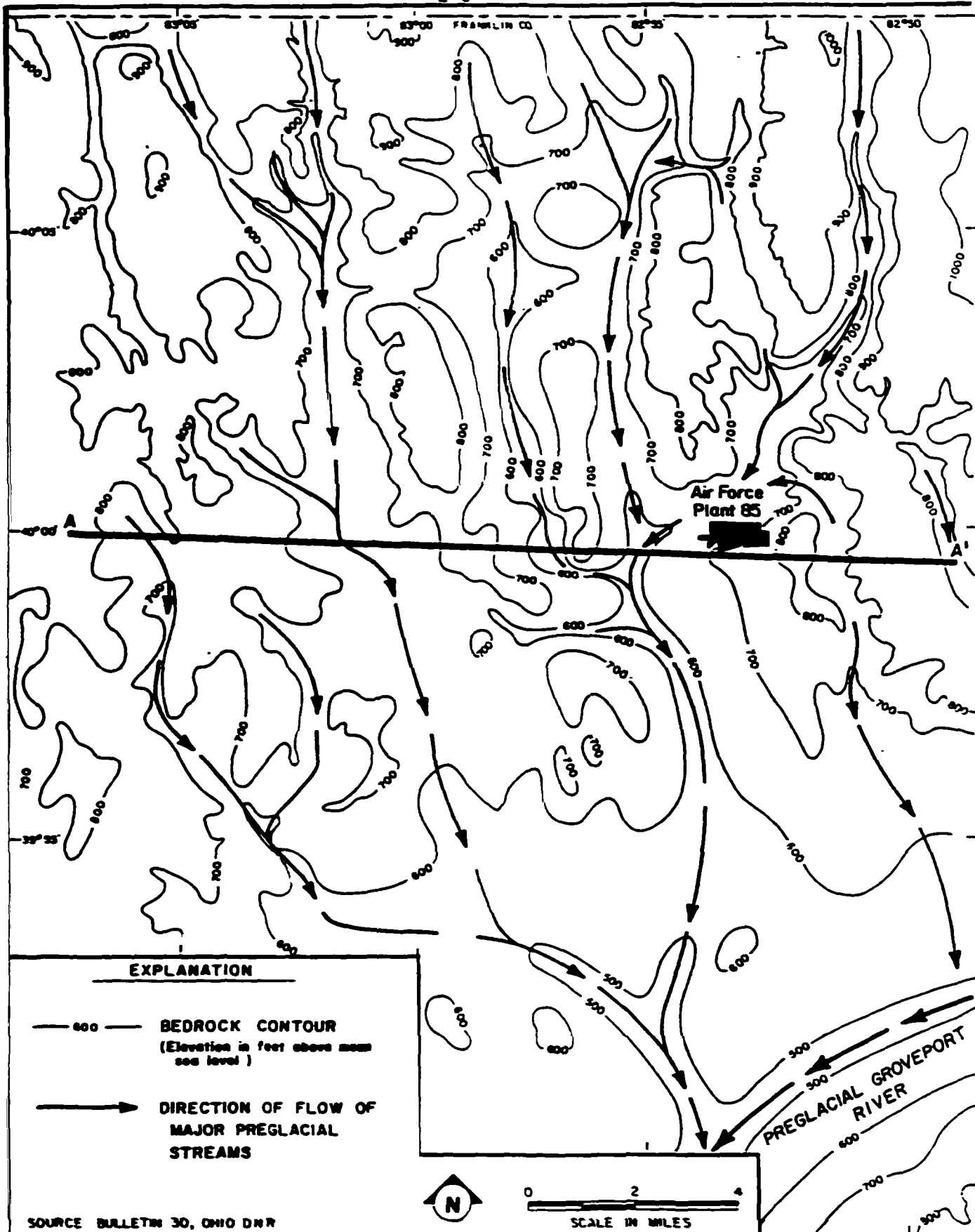


Figure 2-1. Bedrock contours and flow direction of preglacial Groveport River and its tributaries.

River along the general course of present-day Alum Creek. The buried valley created by this tributary is at a depth of approximately 200 feet below the ground surface (bgs) in the area of AF Plant 85 and is filled in with glacial material.

There are basically two types of glacial deposits found in the central Ohio area: glacial outwash and glacial till. Glacial outwash is formed when glacial meltwaters reduce their velocity enough to deposit well-sorted sand- and gravel-sized particles, but still maintain the velocity needed to carry the clay- and silt-sized materials downstream. Glacial till is unconsolidated material which is deposited directly by a glacier without being sorted and reworked by meltwater processes. Therefore, deposits of glacial till consist of a mixture of clay, silt, sand, gravel, and boulders which range widely in size and shape. Evidence of at least two glacial periods, the Illinoian (400,000 to 600,000 years ago) and the Wisconsin (10,000 to 100,000 years ago), are present in the central Ohio area.

Illinoian glaciation left fine sands and gravels in the bottom of the deep preglacial valleys. These fine materials were deposited by quiet meltwaters. (Battelle, 1988b)

During the Wisconsin glacial stage, the ice sheet advanced and retreated several times. With each retreat of the ice sheet (and during other periods of glacial melting), previously deposited glacial tills and outwash deposits were cut by more recent outwash channels. As a result, outwash and till deposits are commonly interbedded, producing sudden lateral and vertical facies changes within relatively short distances.

2.2.2 Bedrock Geology.

The bedrock of the central Ohio area ranges in age from 340 to 410 million years (Late Silurian to Early Mississippian.) (Table 2-3) The Ohio-Olentangy Shale makes up a large part of the Mississippian Period stratigraphy and is the underlying bedrock at AF Plant 85 (Figure 2-2). The thickness of this shale at Plant 85 is not known although in Franklin County thickness of 480 feet has

Table 2-3. GEOLOGIC FORMATIONS IN THE VICINITY OF AF PLANT 85
FRANKLIN COUNTY, OHIO

System	Series	Group or Formation	Maximum thickness, (feet)	Character of material	Water-bearing properties
Quaternary	Recent (alluvium)	Late Stage Mississippian Period	50-100	Silt, clay, and sand deposited on the flood plains of the major streams.	Thin and relatively impermeable.
		Early Stage Mississippian Period	0-350	Sand and gravel (glacial outwash) buried valleys. Layer of clay till may be present below outwash.	Yields less than 2 gpm. Potential ground-water yields depend upon the thickness, regional extent, permeability and source of recharge. Where favorable conditions prevail, wells may yield 1,000 to 1,500 gpm. Typically, wells yield 200 gpm. Where sand and gravel are present in thin scattered lenses interbedded with glacial till, yields are as low as 5 to 10 gpm.
Mississippian	Pleistocene (glacial)	Illinoian Period	0-85	Lenses of fine sand in buried valleys.	Generally not a source of ground water. Usually low in permeability.
		Cuyahoga	185	Alternating gray, sandy shale and blue to grayish sandstone.	Potential yields of up to 30 gpm from sandstone layers.
		Sumbury	35	Black shale.	Poor source of ground water.
		Berea	5-55	Gray to buff-colored sandstone with some shale.	Potential yields of up to 25 gpm.
		Bedford	60-90	Brown to gray shale.	Poor source of ground water.
		Ohio	450	Black shale.	Poor source of ground water.
		Ontonagon	30	Blue shale with some limestone concretions.	Poor source of ground water.
Devonian		Delaware	32	Blue-gray limestone with some thin shaly layers, iron pyrites, and black chert.	Small supplies of up to 3 gpm.
		Columbus	105	Brown to light gray porous limestone.	The principal bedrock aquifer in the county for farm, domestic, small municipal, and industrial supplies. Yields up to 175 gpm.
		Wesley River	373	Dolomitic limestone.	Most important industrial bedrock aquifer. Yields up to 400 gpm or more, usually higher mineralized.

Source: Bulletin 30, Ohio Department of Natural Resources.

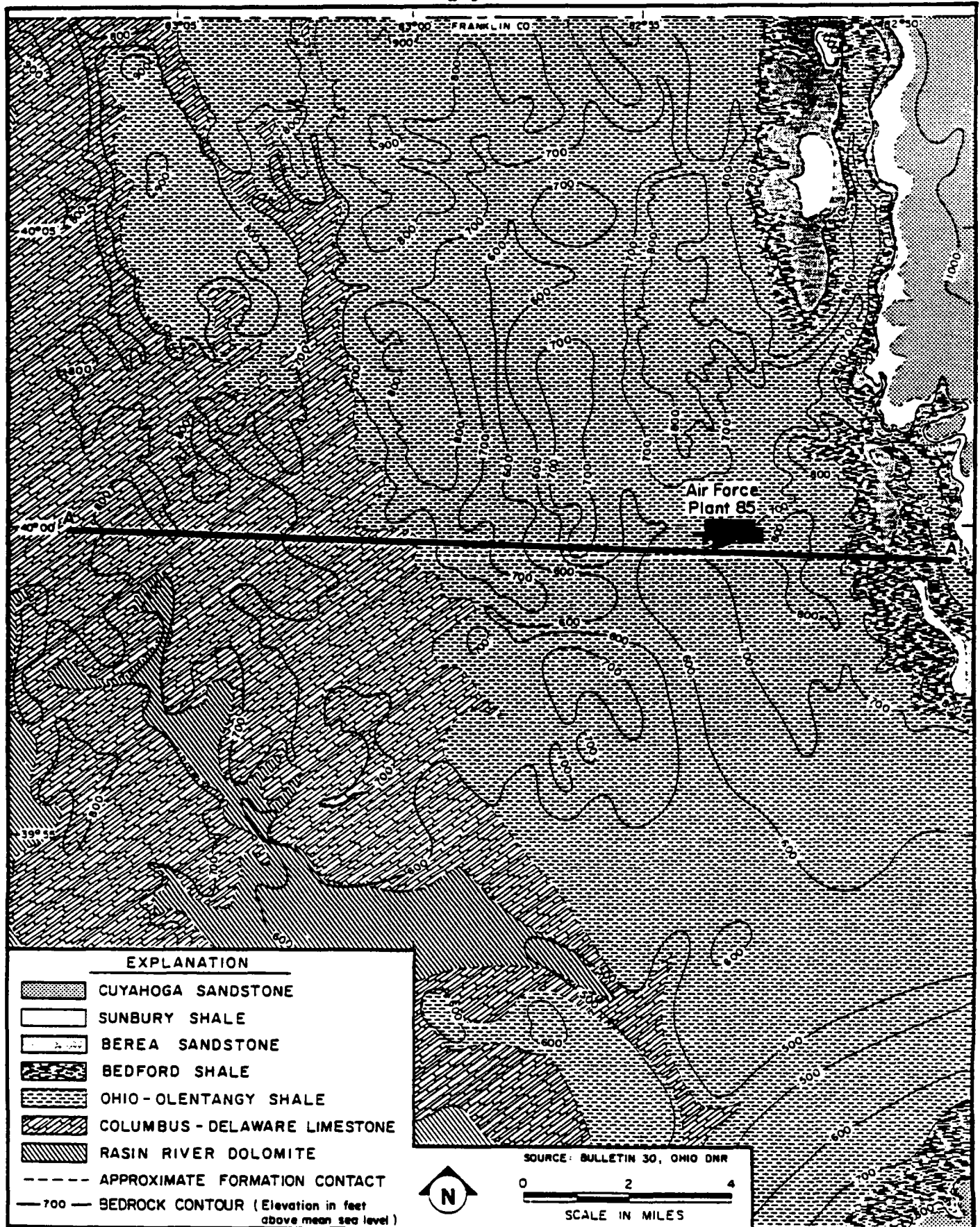


Figure 2-2. Subcrop and bedrock surface in the vicinity of AF Plant 85, Columbus, Ohio.

been recorded (Figure 2-3). The shale is black or dark brown, organic, and somewhat sandy; and it is very fissile (splits into thin slate-like slabs or pieces). Ohio-Olentangy Shale weathers to a gray color. This shale was encountered during sampling of both the Phase II, Stage 1 and RI/FS, Stage 2 investigations and was described as dark gray to black, thinly bedded, and weathered to the maximum 0.5-foot depth sampled.

2.2.3 Surficial Geology

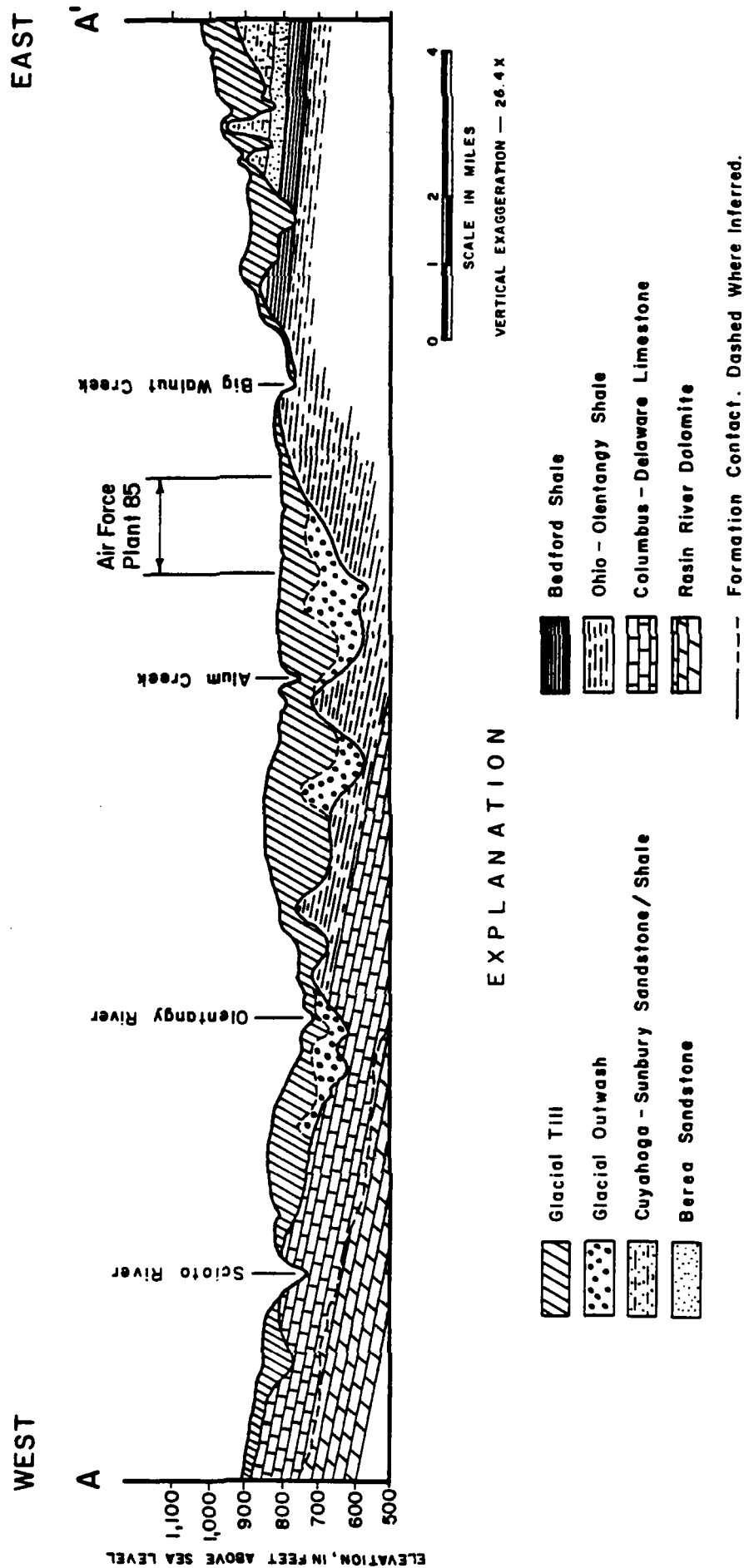
2.2.3.1 Glacial Deposits

The primary surficial deposits at AF Plant 85 consist of glacial outwash and till deposited during the Wisconsin Stage. In Franklin County, considerable evidence indicates that the Wisconsin glaciation took place in two stages. Early Wisconsin glaciation, which occurred about 50,000 years ago, left a thin clay-rich layer of till deposited directly by the ice. This till was then overlain by a relatively well-sorted and stratified sand and gravel deposited by swiftly moving braided streams formed from glacial meltwater. (Battelle, 1988a; Goldthwait, 1958)

The late Wisconsin glaciation occurred about 22,000 years ago. These glacial deposits are predominantly fine sands and clays deposited directly by the ice and can contain outwash lenses up to 50 feet long (Battelle, 1988a; Goldthwait, 1958).

At several places in Franklin County a clay-rich weathered zone overlies the buried lower outwash deposits. This weathered zone has been leached much like modern soil and is interpreted to be a paleo-soil horizon. The horizon serves as a marker between the two Wisconsin glacial stages. (Goldthwait, 1958)

As indicated by geologic logs of boreholes drilled at Plant 85, glacial till generally overlies outwash deposits. The till near the surface ranges in thickness from 10 to 40 feet, while its average thickness across the facility is approximately 25 feet. The interfingering of outwash deposits within previ-



SOURCE: BULLETIN 30, OHIO DNR.



Figure 2-3. Cross-section A-A' (Figure 2-2) of deposits underlying AF Plant 85, Columbus, Ohio.

ously deposited till is apparent within several of the boreholes. The interfingering of outwash deposits and till deposits probably result in isolated and laterally discontinuous water-bearing zones below the Plant. It is also probable that lenses of outwash material occurring at different depths may interconnect, forming a groundwater network. The till composition at AF Plant 85 is primarily sand, silt, and occasional gravel in a clay matrix.

The maximum thickness of the outwash at the Plant is not known. Where the Olentangy was encountered at 50 feet bgs, the outwash was 20 feet thick. The outwash is not of homogenous lithology. Clay layers similar to those encountered in the till are evident in the outwash.

2.2.3.2 Soils

Soils present at AF Plant 85 belong to the Bennington-Pewamo Association. These soils are formed in fine-textured glacial till on relatively flat upland surfaces. The Bennington Series soils consists of yellowish brown, silty clay loams that allow slow percolation, are generally wet, and erode easily. The Pewamo Series soils consist of gray clay loams, which are generally wet to ponded, erode easily, and have a low percolation rate. The distribution of these soils at AF Plant 85 is shown in Figure 2-4. (Battelle, 1988b)

All soils at the Plant are urban land complexes with slopes ranging from 0 to 6%. Table 2-4 summarizes the soil series at AF Plant 85 and presents the characteristic engineering properties of each soil type. The soils are somewhat poorly drained [permeabilities range from 4×10^{-5} to 4×10^{-4} cm/s (CH2M Hill, 1984)].

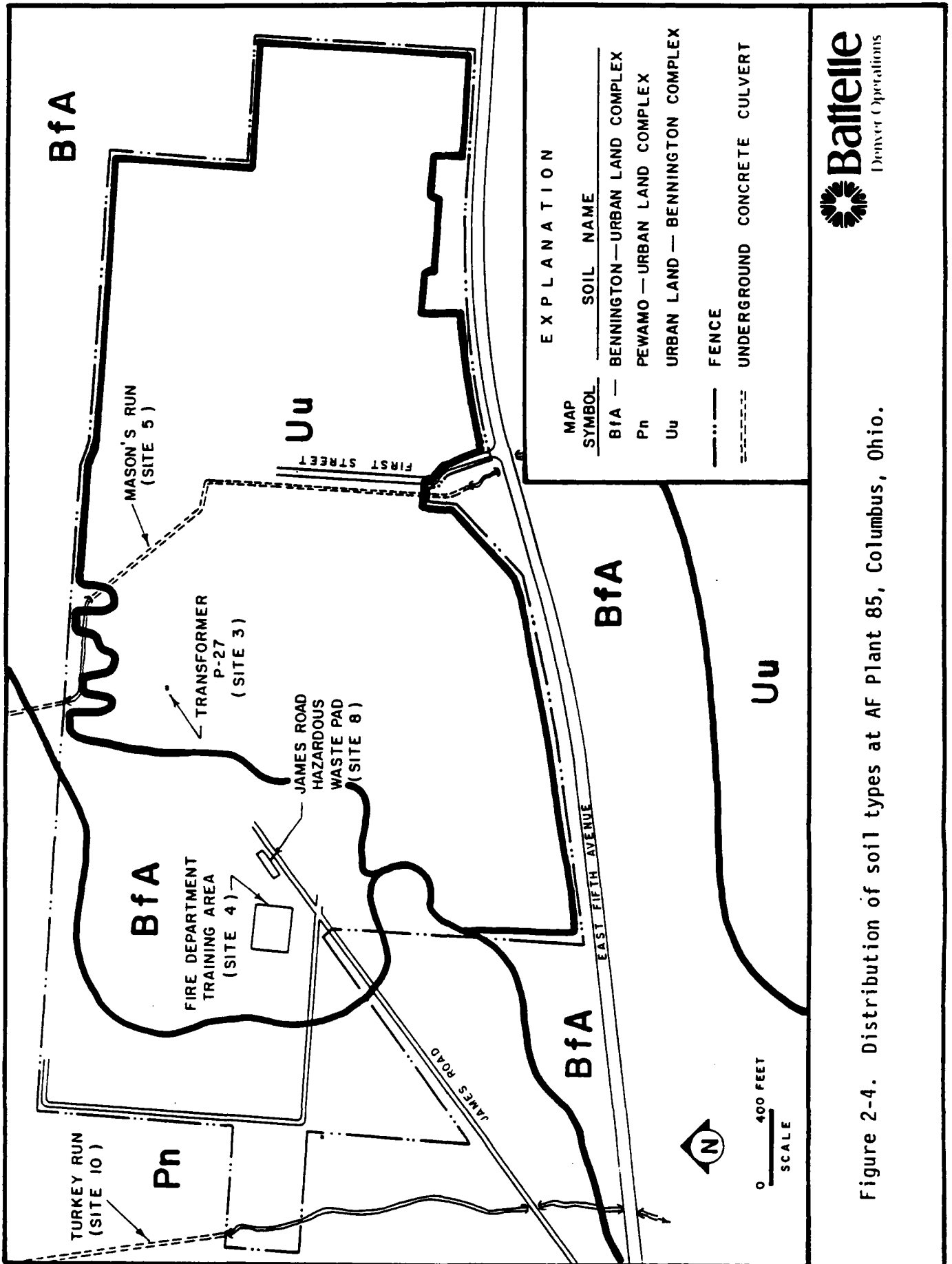


Table 2-4. SOIL TYPES AT AF PLANT 85^a

Soil name	Map symbol	Characteristic permeability, (cm/s)	SCS hydrologic group	Typical percent passing No. 200 sieve	Typical liquid limit	Typical unified soil classification
Bennington--Urban Land Complex	B ₁ A, B ₁ B	4×10^{-5} to 1×10^{-4}	C	70-100	30-60	CL
Pawnee--Urban Land Complex	P _n	1×10^{-4} to 4×10^{-4}	B/D	76-96	35-55	CL, CH
Urban Land--Bennington Complex	U _u	4×10^{-5} to 4×10^{-4}	C	70-100	30-50	CL

^aSource: U.S.D.A. Soil Conservation Service.

2.3 HYDROGEOLOGY

2.3.1 Groundwater

2.3.1.1 Occurrence and Movement

Groundwater in Franklin County is present in three general aquifer systems: Devonian limestone aquifers, Mississippian sandstone aquifers (not present at AF Plant 85), and glacial outwash aquifers.

The lower Devonian rocks, principally the Rasin River and Columbus limestones, are major sources of groundwater supply in western Franklin County (about 5 miles west of the Plant). These carbonate units supply about a third of all groundwater used in Franklin County. Yields of 175 gpm have been obtained in the Columbus Formation and as much as 400 gpm have been obtained in the combined Columbus-Rasin River limestone aquifer (CH2M HILL, 1984). Groundwater is present in fractures, joints, and crevices within the limestone; therefore, well yields are dependent on rock solubility and extent of cavities due to solution within the limestone.

The glacial deposits in the central portion of Franklin County yield groundwater at rates from 1,500 gpm to as little as 2 gpm. The greatest yields are obtained from the outwash deposits, which filled the preglacial Groveport River Valley. Glacial outwash deposits are present beneath a portion of Alum Creek, a little more than 1 mile to the west of AF Plant 85, and in pockets below Big Walnut Creek, less than 1 mile to the east. The southwestern portion of AF Plant 85 is underlain by sand and gravel outwash deposits, associated with a buried preglacial bedrock valley, which can yield as much as 200 gpm. Typically, these deposits are covered with thick clayey till which limits the potential recharge. (Goldthwait, 1958)

Most of the remaining portion of the Plant site is underlain by lenses of sand and gravel outwash deposits interbedded in clayey till which overlies the bedrock (Ohio-Olentangy Shale). Yields of as much as 25 gpm are typically obtained north of 17th Street where the deposits can reach 200 feet in thickness

within a buried bedrock valley. In the area of Mason's Run, yields from irregular and thinly scattered sand and gravel lenses are only 5 to 10 gpm. The eastern portion of the site between Mason's Run and Big Walnut Creek is underlain by thin glacial till over the relatively impermeable shale bedrock. This Ohio-Olentangy Shale is rarely used for water supply except in limited weathered zones and serves as an effective confining layer separating the artesian limestone aquifers from the more permeable overlying deposits. Well yields are typically less than 2 gpm in this area. (CH2M HILL, 1984)

Recharge to the glacial aquifer occurs through infiltration from creeks and streams. A minor amount of recharge occurs through direct infiltration of precipitation. The low-permeability clay till encourages runoff of precipitation rather than infiltration. (Battelle, 1988b)

During the RI/FS, Stage 2 investigation, two water-bearing zones were identified in the surficial deposits underlying AF Plant 85. In general, the shallow zone lies within the glacial till, while the other deeper zone is roughly screened within the glacial outwash. However, due to the variability and interbedded nature of these glacial deposits, the depth of the screened interval does not necessarily place the water-bearing zone definitely in either the till or the outwash. The potentiometric surface of each of these zones is shown on Figures 2-5 and 2-6, respectively.

In the northeast portion of Franklin County, the principal source of groundwater is from the Mississippian Berea Sandstone formation. The sandstones are relatively permeable deposits which may yield between 25 to 70 gpm of groundwater. The higher yields are obtained primarily from highly fractured zones. The deposits are not major sources of groundwater in Franklin County due to the lack of fractures and the thinness of the strata.

2.3.1.2 Well Inventory in the Vicinity of Plant 85

Since 1949, the Ohio Department of Natural Resources, Division of Water, has required that a copy of the drilling record for any newly constructed or modified well be filed with the Division. Numerous potable water supply wells

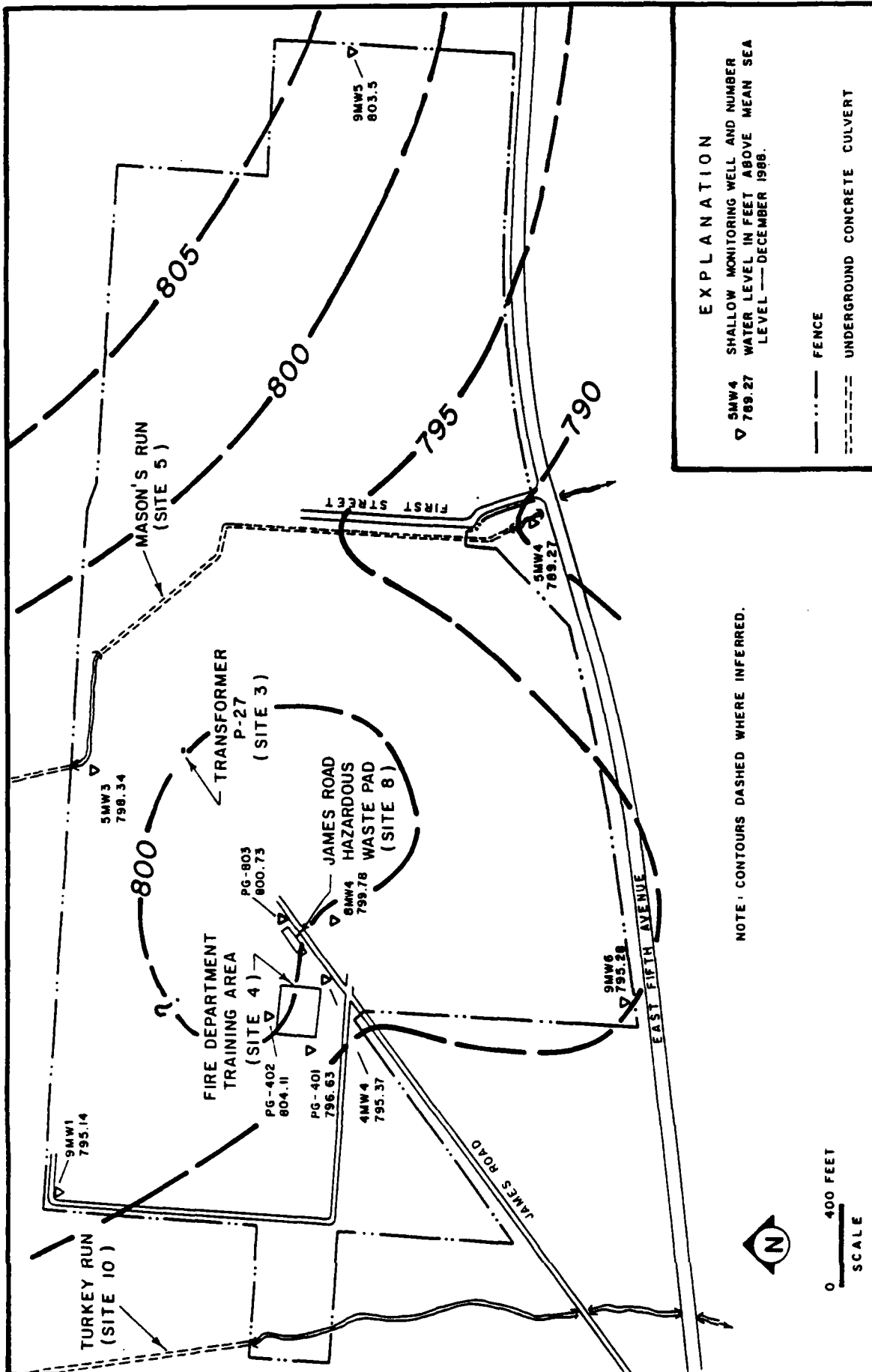
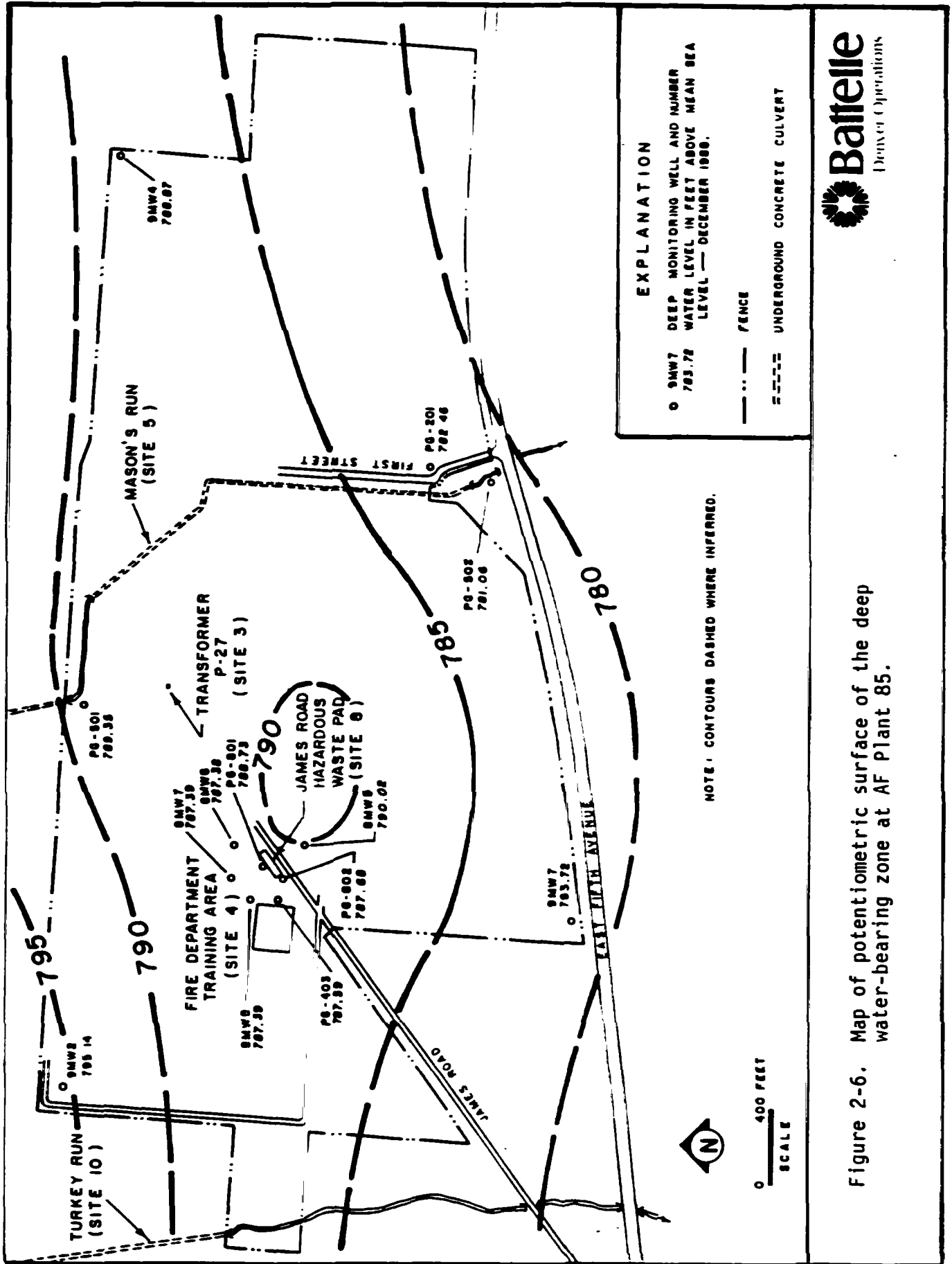


Figure 2-5. Map of potentiometric surface of the shallow water-bearing zone at AF Plant 85.



have been drilled near and on the AF Plant 85 property. These wells were developed in glacial outwash. Approximately 1,000 wells may be located within a 3-mile radius of the Plant. An estimated 50 to 100 private wells may still be in use within a 3-mile radius of AF Plant 85. A partial listing of these wells may be found in Table 2-5, while Figure 2-7 shows the well locations.

2.3.2 Surface Water

AF Plant 85 is located within the drainage basin of Big Walnut Creek, a tributary of the Scioto river. The general direction of surface water drainage at AF Plant 85 is shown in Figure 2-8. Surface water runoff from the Plant discharges into two creeks: Turkey Run, located in the western portion of the site, and Mason's Run, located in the central Plant area. Both creeks enter the Plant site from the Port of Columbus International Airport to the north of AF Plant 85 and flow south. These streams eventually join Big Walnut Creek about 5 miles south of the facility. Flow within these creeks is generally low except during periods of precipitation. Due to the large proportion of paved area and relatively impermeable surface soil, runoff is highly dependent on storm events.

An extensive stormwater drainage system has been constructed throughout the main Plant area which discharges to Mason's Run at the Plant entrance gate. Miscellaneous fuel spills and oily discharges to Mason's Run have been reported in the past which resulted in the construction of an oil skimmer system in the creek near the entrance gate.

No other surface water features are present at the Plant site. No wetlands or swampy areas are located at or near the Plant. Flooding is limited to the localized creek beds.

Surface waters are the primary source of municipal water supplies in Franklin County. The Morse Road Treatment Plant, which provides water to AF Plant 85, is supplied by Hoover Reservoir and also serves the northern and eastern portions of the city of Columbus. Hoover Reservoir, located 8 miles north of AF Plant 85 on Big Walnut Creek, is used for both water supply and

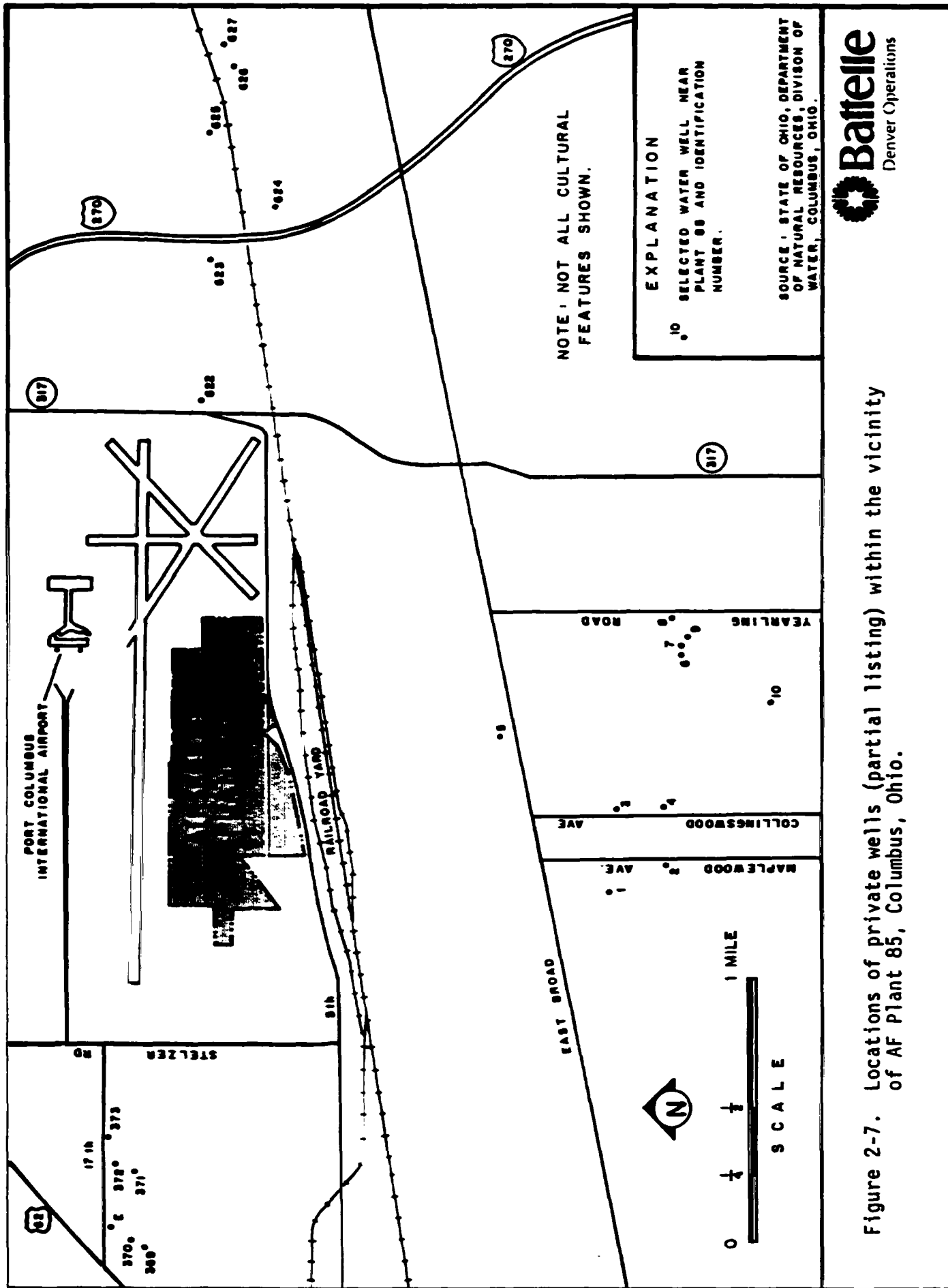
Table 2-5. Inventory of Selected Wells in the Vicinity of AF Plant 85

Well #	Location of Well	Depth (in feet)	Length of Casing (in feet)	Length of Screen (in feet)	Depth to Water (in feet)	Date Installed (mon-dy-yr)
Franklin County Truro Township Wells						
1	192 Barnett Rd	55	63	2	26	12-04-56
2	307 Maplewood Ave	39	34	5	18	2-22-55
3	236 Collingwood Ave	95	90	4	35	6-16-53
4	354 Collingwood Ave	138	98	40	27	6-15-56
5	4000 E. Broad St	83	77	6	35	5-27-55
5	4000 E. Broad St	77	72	5	35	6-02-55
6	4227 Siegman Rd	32	30	?	8	12-10-54
7	4235 Siegman Rd	28	28	?	8	12-05-54
8	449 Yearling Rd	30	25	5	?	10-16-53
9	1 Mile North of US Rt 40 1/4 Miles East of Yearling Rd	50	40	10	25	9-11-54
10	4006 Washburn	43	41	2	19	8-??-54
Franklin County Mifflin Township						
369	500 Feet South of Rt 2 on Steltzer Rd	64	64	?	59	8-10-60
370	29161 Lamb Ave	90	90	?	60	6-01-64

Table 2-5. Inventory of Selected Wells in the Vicinity of AF Plant 85 (Continued)

Well #*	Location of Well	Depth (in feet)	Length of Casing (in feet)	Length of Screen (in feet)	Depth to Water (in feet)	Date Installed (mm-dd-yr)
371	Lamb Ave off State Rt 62	66	66	?	55	5-15-67
372	3155 17th Ave	81	81	?	55	12-14-65
373	17th & Sterling Ave	72	72	?	50	4-11-52
E	3015 17th Ave	98	98	?	61	8-12-64
Franklin County Jefferson Township						
622	East of Port Columbus West of Walnut Creek	86	56	30	25	8-16-57
623	571 Morrison Rd	?	10	?	15	9-03-51
624	1 Mile North of Rt 16 On Morrison Rd	60	23	?	3	3-30-61
625	Columbus Clay Co.	100	25	?	15	12-14-64
626	1/4 Mile North of East Broad Off Westside Taylor Station Rd	75	25	?	?	11-22-61
627	Taylor Station Rd	200	60	4	78	10-16-81

* = Well numbers assigned by State of Ohio, Department of Natural Resources, Division of Water
 ? = Lengths not recorded on well log and drilling report



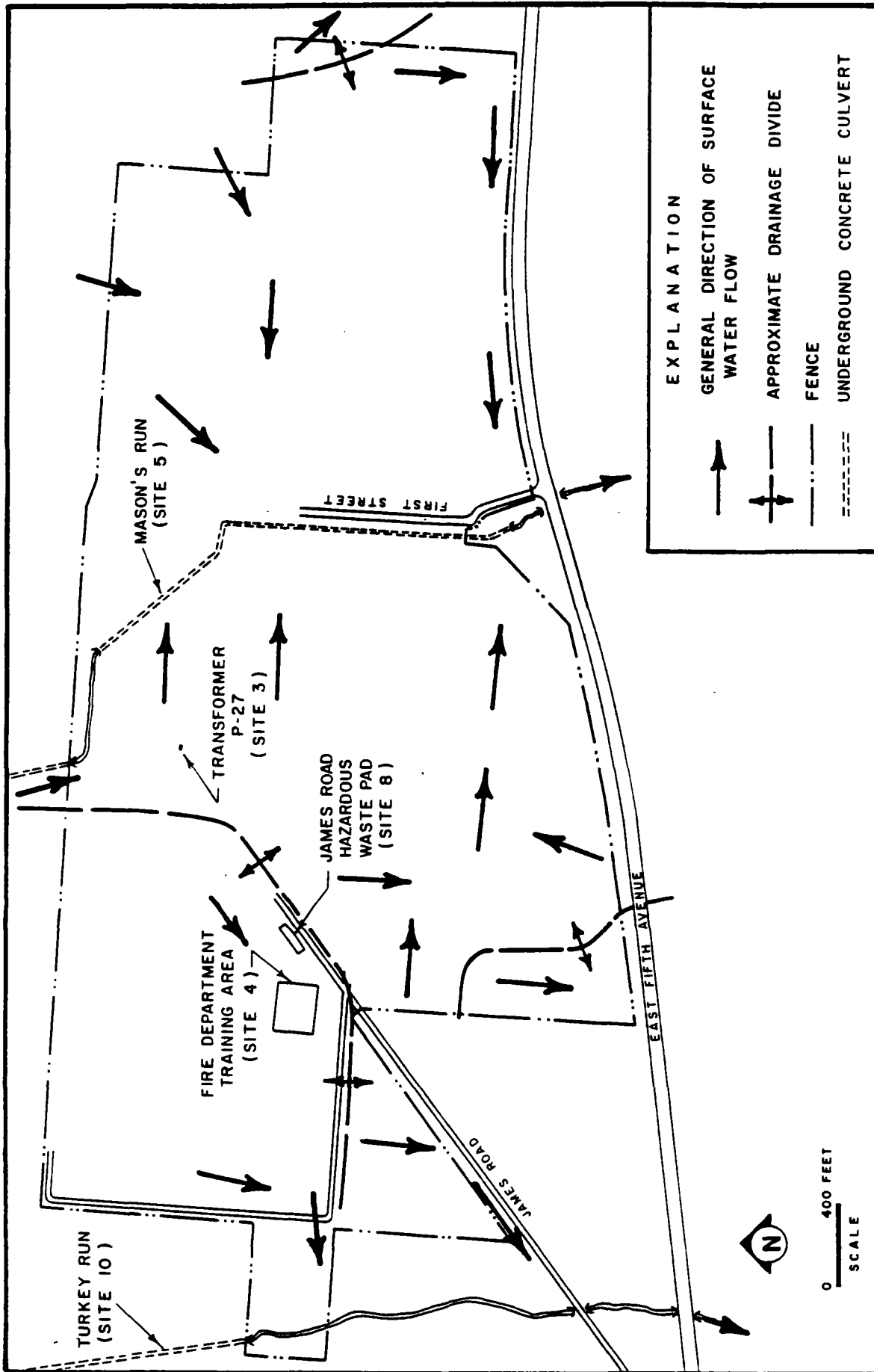


Figure 2-8. Map showing general direction of surface water drainage at AF Plant 85, Columbus, Ohio.

flood control. Regulations to protect public water supplies fall under the jurisdiction of the Ohio EPA.

No known surface water supplies are present within 3 miles downstream of AF Plant 85.

2.4 AIR QUALITY

Estimates of air quality are based on the levels of the following criteria pollutants: ozone, carbon monoxide, nitrous oxide, lead, sulfur dioxide, and total suspended particulates (TSP). The Ohio EPA has a current official designation of "attainment" on all these pollutants except carbon monoxide and TSP. Carbon monoxide level is below the standard. TSP is considered a nuisance, although not a health hazard in terms of the Pollution Standard Index (PSI) for the Columbus area, which is based on measurements of either TSP or ozone. On a scale of 0 (no pollution) to 100 (air quality standard level), ozone levels in Columbus have created a PSI of 60 to 70 in summer. However, neither ozone nor TSP has reached a PSI of 100 in the last few years.

2.5 BIOLOGY AND ECOLOGY

The flora and fauna in the vicinity of AF Plant 85 are indigenous to any urban industrialized site in the Columbus area. The main Plant area is almost entirely covered with buildings, parking lots, and paved areas. The former radar test range west of the main Plant area is covered with field grass, which is maintained by regular mowing. The remaining 174 acres west of Stelzer Road is covered with miscellaneous brush growth and young trees, including sycamores and common shade trees. A strip of field grass about 50 feet wide is maintained adjacent to the FAA Instrument Landing System. Because the area is located at the end of the runway for the Port of Columbus International Airport, the vegetation at the strip is cleared approximately every 10 to 15 years. (Battelle, 1988a)

Urban, industrial, commercial, and residential zones surround the Plant. According to the Ohio Division of Natural Areas and Preserves, locations of

major habitats of threatened or endangered species or other significant natural areas within 3 miles of the Plant include:

1. A 1-mile stretch of Big Walnut Creek south of Morse Road approximately 1 mile north of Gahanna and 4 miles upstream from AF Plant 85, is the habitat of Hiodon tergisus (Mooneye), a state endangered fish.
2. A 2,000-foot stretch of Big Walnut Creek in Gahanna, approximately 1 mile northeast of and upstream from AF Plant 85, is the habitat of Etheostoma maculatum (spotted darter), a state endangered fish.
3. The Gahanna Woods Natural Preserve, approximately 3 miles northeast and upstream of AF Plant 85, is owned by the city of Gahanna Parks. The preserve comprises over 50 acres, where visitors can enjoy four different habitats. Small woodland ponds and a button bush swamp-forest rings these areas, followed by oak/hickory and beech/maple associations on the higher and drier sites. Woodland wild flowers include the yellow water crowfoot, Canada lily, swamp saxifrage, wild hyacinth, skunk cabbage, and trillium. The preserve also includes an old field community of goldenrods, sunflowers, and asters.
4. A 6-acre area of land immediately south of Gahanna Woods is the habitat for the Hemidactylium scutatum (four-toed salamander), a state endangered salamander.

All of these areas are upstream and upgradient, but downwind of AF Plant 85; therefore, some Plant activities could affect them.

2.6 CLIMATOLOGY

The climate at AF Plant 85 is, for the most part, temperate continental. Cool air masses, frequently from central and northwestern Canada, and occasionally from the Hudson Bay Region during spring months, affect this region. In the summer months, tropical masses from the Gulf of Mexico reach Franklin County. The general circulation sometimes brings showers or snow from the Atlantic.

Temperature and precipitation data for the region are summarized in Table 2-6. December, January, and February have the lowest normal minimum temperatures; between 20 and 23°F. June, July, and August have the highest normal maximum temperatures; between 82 and 85°F. The average date of the first freeze in the fall is October 31, and the average date of the last freezing temperature in the spring is April 16.

The area does not have distinct "wet" and "dry" seasons, but average precipitation is generally greater in the spring and early summer than in the fall. The average annual precipitation is about 37 inches per year with about 28 inches occurring as snowfall. Thunderstorms occur on an average of 42 days each year, mostly in the summer. Mean annual lake evaporation, commonly used to estimate the mean annual evapotranspiration rate, is about 33 inches per year. The difference between the mean annual precipitation and the mean annual evapotranspiration gives an annual net precipitation of 4 inches per year.

The prevailing wind is from the south-southwest. Average wind speed ranges between 7 and 10 miles per hour on a monthly basis.

Table 2-6. METEOROLOGICAL DATA SUMMARY FOR COLUMBUS, OHIO

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
<u>Temperature (°F)</u>													
Record High	74	73	85	89	94	102	100	100	100	90	80	76	102
Record Low	-19	-13	-2	14	25	35	43	39	31	20	5	-10	-19
Normal Maximum	36.4	39.2	49.3	62.8	72.9	81.9	84.8	83.7	77.6	66.4	50.9	38.7	62.1
Normal Minimum	20.4	21.4	29.1	39.5	49.3	58.9	62.4	60.1	52.7	42.0	32.4	22.7	40.9
Normal Mean	28.4	30.3	39.2	51.2	61.1	70.4	73.6	71.9	65.2	54.2	41.7	30.7	51.5
<u>Precipitation (Inches)</u>													
Record Maximum (in 24 hours)	4.81	2.15	3.40	2.37	2.72	2.93	3.82	3.79	4.86	1.87	2.05	1.74	4.86
Normal Mean	2.87	2.32	3.44	3.71	4.10	4.13	4.21	2.86	2.41	1.89	2.68	2.39	37.01
Mean Snowfall	8.7	6.0	4.6	0.8	Trace	0.0	0.0	0.0	Trace	Trace	2.7	5.6	28.4

Period: 1939-1982

Source: United States Department of Commerce, National Climatic Data Center as cited in CH2M-Hill, 1986.

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3.0 FIELD INVESTIGATION PROGRAM

3.1 ORGANIZATION AND DEVELOPMENT OF THE FIELD PROGRAM

3.1.1 Remedial Investigation

The remedial investigation for the RI/FS Phase II, Stage 2 was based on the findings and recommendations from the Phase II, Stage 1 investigation at AF Plant 85, Columbus, Ohio. A Work Plan (Battelle, 1988a) was generated which detailed the recommendations and decision rationale for conducting field work, performing a qualitative risk assessment, developing and screening potential remedial responses, and determining Applicable or Relevant and Appropriate Requirements (ARARs) and Data Quality Objectives (DQOs).

Field work began 19 September 1988 and was completed 16 December 1988. Field work conducted may be found on Table 3-1. The Phase II, Stage 1 report included a Technical Document to Support No Further Action/Record of Decision (TDSNFA/ROD) for the Coal Pile, Site 2. Turkey Run (Site 10) was added as a result of the Stage 2 Pre-survey to the investigations for RI/FS, Stage 2; also, the decision was made to install and sample perimeter monitoring wells.

The approach for investigating the sites at AF Plant 85, as specified by the Statement of Work and the Work Plan (Battelle, 1988a) for the RI/FS, Stage 2 investigation, included: installation of groundwater quality monitoring wells, determination of aquifer properties using slug tests, an aquatics survey, hand-augered shallow soil borings, 10-foot soil borings drilled by hollow stem auger, and the collection of soil, sediment, surface water, and groundwater samples for chemical analyses of selected parameters and for permeability, grain size distribution, and moisture content of designated soil samples.

3.1.2 Risk Assessment

Risk assessments will be performed as needed on a site-by-site basis, depending on the level of contamination detected and on the toxicity of the contaminants identified. The risk assessment will be performed as part of the remedial investigation, which will aid in determining those sites that carry

**Table 3-1. Field Activities and Samples
by Site, AF Plant 85, Columbus, Ohio**

	Site 3	Site 4	Site 5	Site 8	Site 10	Perimeter Wells
<u>Soils:</u>						
Hand-augered						
# of Boreholes	8					
# of Samples	1-2/hole			2-3/hole		
Auger-drilled						
# of Boreholes	3	1	2	5		7
# of Soil Samples	4/hole	3				
Converted to monitoring well		1	2	5		7
Engineering Parameters						
Permeability		1		2		4
Grain-size dist.		1	3	6	2	9
Moisture		1	3	6	2	9
Sediment			3		2	
<u>Water:</u>						
Groundwater Sampling						
New Wells		1	2	5		7
Existing Wells		3	2	3		1
Surface Water			2		2	
Slug Test		4	2	8		6
Ecology Study			1			

potential risk to human health and welfare or the environment from the contaminants identified at the various sites investigated. According to U.S. EPA guidance (1988), a risk assessment involves four steps:

1. Hazard Identification: The determination of whether a particular chemical is or is not causally linked to particular health effects.
2. Dose-Response Assessment (Exposure): The determination of the magnitude of exposure and the probability of occurrence of the health effects in question.
3. Exposure Assessment: The determination of the extent of human exposure before or after application of regulatory controls.
4. Risk Characterization: The estimation of the potential for adverse health or environmental effects based on carcinogenic risks, non-carcinogenic risks, and environmental risks.

3.1.3 Feasibility Study

The primary purpose of the feasibility study process is to develop remedial alternatives that protect human health and the environment. From U.S. EPA (1988), three steps are involved in the process:

1. Development of Alternatives: Identify potential treatment technologies, disposal requirements for residuals or untreated wastes, and identify action specific ARARs.
2. Screening of Alternatives: Reduce the number of alternatives for detailed analysis, while preserving a good range of options.
3. Detailed Analysis of Alternatives: The alternatives are further evaluated using the nine criteria specified by U.S. EPA and compared against each other.

3.2 DATA QUALITY OBJECTIVES

The development of data quality objectives ensures that the level and extent of sampling and analysis conducted during the RI/FS, Stage 2 investigation is consistent with the data requirements to produce an adequate

evaluation of remedial alternatives in the Feasibility Study. A three step approach to develop the DQOs was used:

- o Initial identification of overall information needs
- o Development of field program to satisfy remaining data needs once existing information has been reviewed
- o Selection of sampling and analytical methods to achieve objectives of field program.

The Work Plan and the Quality Assurance Program Plan (QAPP) were developed to meet these objectives.

3.3 IMPLEMENTATION OF THE FIELD PROGRAM AND A SUMMARY OF THE WORK PERFORMED

3.3.1 Time Sequence of the Work Performed

The field investigation for RI/FS Stage 2 began on 19 September 1988 and was completed in December of the same year.

3.3.2 Identification and Role of Subcontractors

Brown and Caldwell Laboratories from Pasadena, California provided chemical analyses of all soil, sediment, and water samples. The drilling subcontractor was Mason-de Verteuil of Columbus, Ohio. They also analyzed selected soil samples for grain size distribution, moisture content, and permeability. The survey work was performed by John E. Foster Associates of Columbus, Ohio.

3.4 INVESTIGATION METHODS AND SURVEYS CONDUCTED

3.4.1 Surveying of All Sampling Locations

Two pieces of surveying equipment were used by the subcontractor. A Top-Con AT-F2 was used as a level and a Top-Con GTS-3B was used for measuring horizontal and vertical distances. A permanent iron pipe marker, placed during

the Phase II, Stage 1 surveying, is located in the southwest corner of the facility.

3.4.2 Stream Water Gaging

Stream water gaging was planned for Mason's Run and Turkey Run. Field activities were performed during the winter months when the streams were at their lowest flow. Turkey Run was frozen and Mason's Run, although not frozen at the upstream location, had a negligible flow. The downstream location of Mason's Run was too narrow to allow for a flow measurement to be taken with the flow meter. Discharge was measured first by defining the geometry of the stream, and then the velocity was measured by placing an object at an upstream point and clocking the time it took to arrive at a specified downstream point. This procedure was performed several times to achieve as accurate a measurement as possible.

3.5 DRILLING AND BOREHOLE PROGRAM

3.5.1 Number of Boreholes and Wells Installed

Eighteen (18) boreholes were drilled at AF Plant 85 during the RI/FS, Stage 2 field investigation. Of these 18 boreholes, 15 were converted to groundwater monitoring wells and ranged from 14 to 64 feet deep. The boreholes not completed as monitoring wells were 10 feet deep.

A Central Mine Equipment (CME) 55 drill rig was used to install all monitoring wells. The technique used was hollow stem augering. The methodology is detailed in Section 3.5.2 (Monitoring Well Installation). The auger drilling method was chosen because it allows for a more accurate description of geologic conditions which aids in determining the presence or absence of contaminants.

Table 3-2 provides a summary of wells and boreholes drilled in both field investigation periods.

Table 3-2. Well Inventory at AF Plant 86

Well Number	Survey Coordinate	Relative Depth/ Lithology of Screened Interval	Depth to Bedrock where Known	Elevation of Screened Interval	Ground Elevation	Water Level Elevation December 86	Water Level Elevation March 86	Total Depth Drilled (ft)	Depth to Screen (ft)
9M1	N7789 45 E4176.43	S/Outwash		794.30 to 793.00	804.50	795.14	NA	25.0	18.2
9M2	N7793.00 E4177.30	D/Transition		772.40 to 751.00	804.40	795.14	NA	55.4	34.5
9M3	N7450.00 E9197.20	S/Transition		791.82 to 791.32	809.02	788.04	NA	29.0	17.8
9M4	N7455 25 E9291.30	D/Outwash	48.0	790.49 to 789.99	809.59	788.87	NA	44.0	19.1
9M5	N8349.70 E3752.10	S/Till	14.0	797.54 to 797.04	805.04	805.50	NA	19.0	8.5
9M6	N5027 83 E5120.00	S/Till		791.05 to 791.15	800.32	795.20	NA	19.0	7.5
9M7	N6024 00 E5129.54	D/Outwash		777.16 to 756.06	800.50	783.72	NA	64.0	23.0
8M4	N6443 29 E5514.00	S/Transition-Till		797.00 to 797.40	804.30	799.70	NA	21.0	8.4
8M5	N6440 00 E5513.43	D/Interbedded		773.30 to 752.00	804.30	790.82	NA	51.5	31.0
8M6	N6011.73 E5509.30	D/Outwash		773.00 to 753.40	805.50	787.30	NA	53.0	31.6
8M7	N6027 91 E5342.04	D/Outwash		773.40 to 752.00	805.00	787.30	NA	54.0	32.5
8M8	N6723 07 E5229.00	D/Outwash		772.50 to 752.00	805.50	787.30	NA	54.0	33.5
5M3	N7010 38 E9254.01	S/Transition-Till		791.00 to 791.40	805.20	798.34	NA	24.0	15.0
5M4	N6453 91 E7470.00	S/Transition		783.00 to 773.30	799.40	789.27	NA	29.0	13.1
4M4	N6404 39 E5230.01	S/Till		791.10 to 780.00	804.00	795.37	NA	24.0	13.5
PQ-201	N6776.37 E7510.32	D/Till		789.20 to 759.20	804.03	781.00	782.40	45.0	28.0
PQ-401	N6549.00 E4807.50	S/Till		791.50 to 791.50	804.50	795.03	795.14	27.5	13.0
PQ-402	N6750.11 E5054.74	S/Till		801.50 to 791.50	800.50	804.11	800.49	10.5	5.0
PQ-403	N6599.20 E5210.05	D/Outwash		776.20 to 766.20	805.20	787.59	789.49	40.0	29.0
PQ-501	N7019.10 E9287.93	D/Interbedded	45.0	784.70 to 759.70	804.70	789.35	791.49	45.0	20.0
PQ-502	N6455.44 E7473.10	D/Outwash	50.0	775.00 to 745.00	799.30	781.00	770.90	53.5	23.5
PQ-901	N6900.97 E5413.50	D/Interbedded		781.00 to 771.00	804.90	788.73	790.19	33.0	23.0
PQ-902	N6559.80 E5340.31	D/Till		774.00 to 764.00	805.30	787.00	789.20	40.5	30.5
PQ-903	N6003.40 E5330.27	S/Transition		800.20 to 790.20	805.20	800.73	802.00	10.5	5.0

* Lithologic descriptions: D = Deep S = Shallow

Outwash - well-sorted sand and gravel with minor amounts of silt and/or clay.

Transition zone - poorly sorted mixture of sand, silt, and clay with silt the predominant fraction.

Till - clay with minor amounts of silt and/or sand.

Interbedded - zone where alternating layers of till and outwash are present.

NA = Not applicable These wells were installed in winter 1988.

Note: All elevations are given in feet above mean sea level.

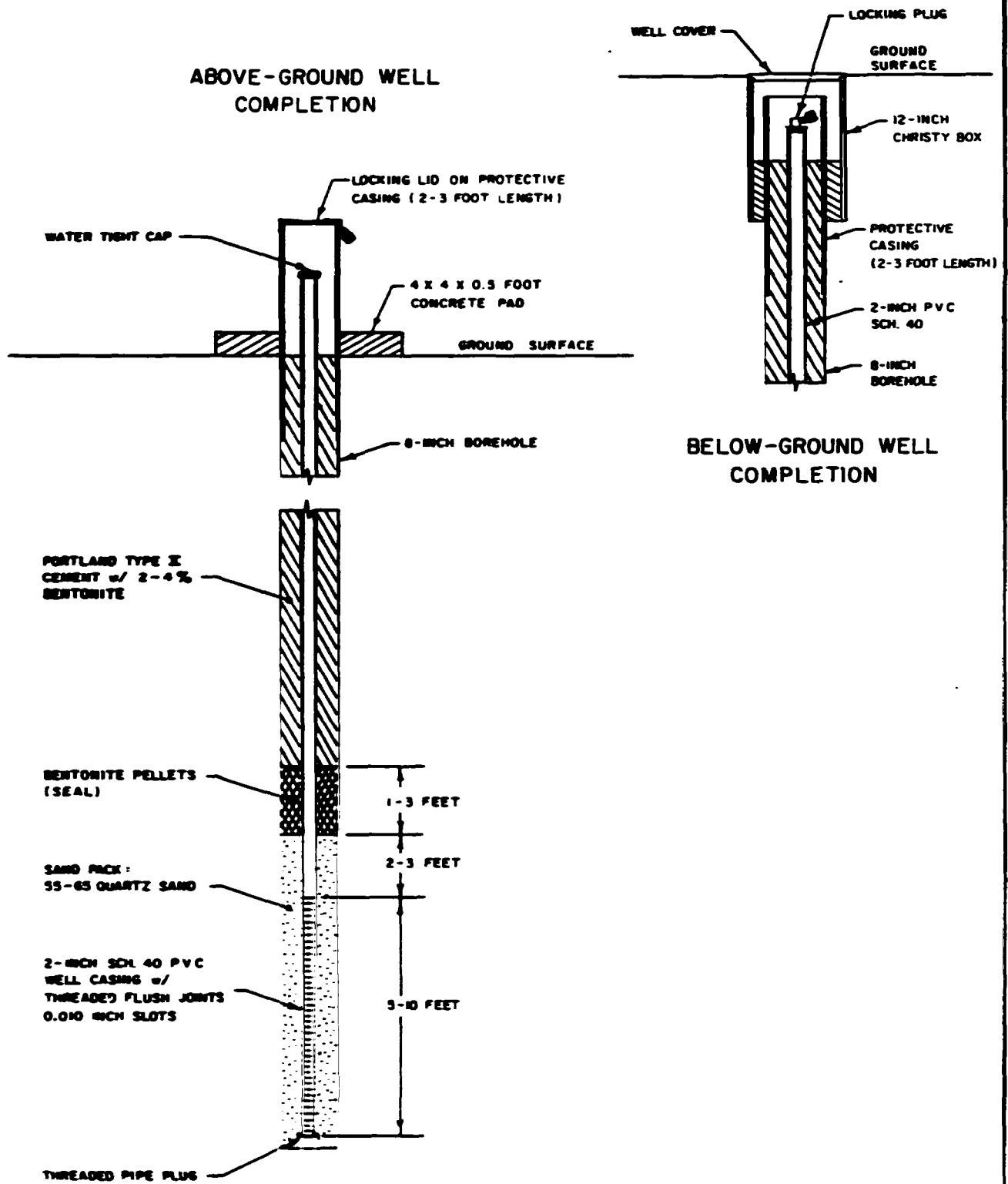
Figure 3-1 illustrates a typical above- and below-ground completion for the shallow wells, while Figure 3-2 illustrates a typical above- and below-ground completion for the deeper wells.

3.5.2 Monitoring Well Installation

Fifteen (15) monitoring wells were installed at AF Plant 85 during the RI/FS, Stage 2 investigation. All the wells were completed with 2-inch Schedule 40 PVC with 0.010 inch screened slots. Eight shallow wells were constructed with an average depth of 24 feet. These shallow wells had 10-foot sections of screen with 5 to 8 feet of the screen in the saturated zone. The seven deeper wells were constructed at an average depth of 52 feet. These wells had 10- to 20-foot screened sections, depending on the thickness of the saturated zone. Table 3-3 lists the monitoring wells installed during both stages of study and the lithologic facies in which they were screened.

After a decision was made on the length of the screen to use in the well, the blank PVC casing, screened section, and end cap were lowered down through the augers in sections and attached together using flush-threaded casing. In some cases, the deeper holes had to be held open by water due to heaving sands entering the auger. The sand inflow prevented the placement of the well casing at the desired depth.

Drilling of the deep wells was begun using 12-inch OD augers. When the confining layer was first encountered, a permanent 8-inch OD PVC conductor was positioned in the borehole. This prevented cross contamination from the upper water-bearing zone to the lower one. The conductor pipe section was filled with grout and allowed to harden overnight. The grout provided an additional seal between the upper and lower aquifers. Eight-inch augers were used to drill the grout plug and, subsequently, into the deeper water-bearing zone. Split-spoon samples and Organic Vapor Analyzer (OVA) readings were taken every 5 feet during the course of the drilling and detailed lithologic descriptions were recorded in the drilling log. Typical well constructions are illustrated in Figures 3-1 and 3-2.



NOT TO SCALE

Figure 3-1. Typical above and below ground completion for well completed in till, AF Plant 85.

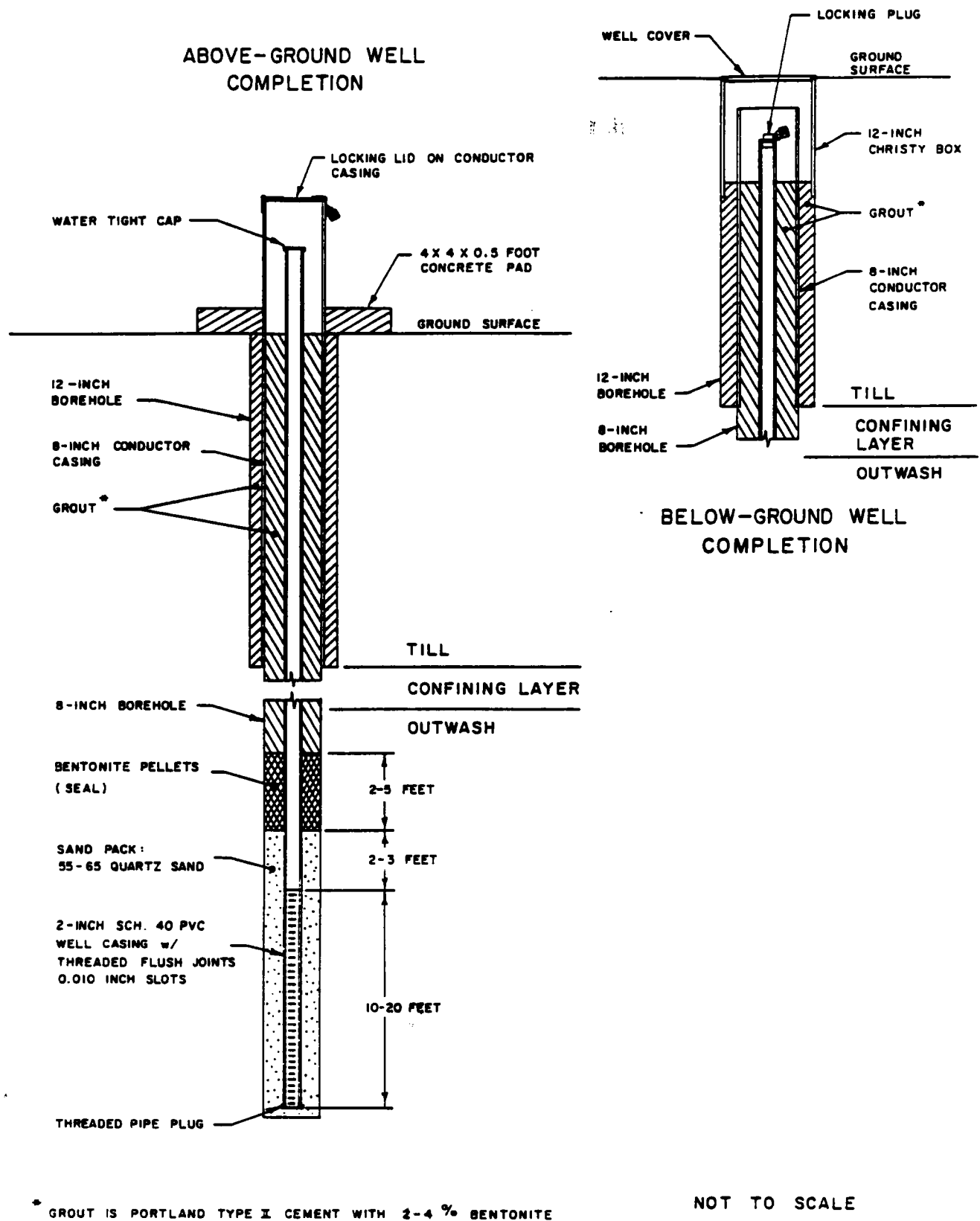


Figure 3-2. Typical above and below ground completion for well completed in outwash, AF Plant 85.

Table 3-3. Borehole Inventory at AF Plant 85

Bore Number	Survey Coordinates		Elevation	Total Depth
384	N7148.46	E6350.50	805.01	10.0
385	N7148.80	E6354.93	805.03	10.0
386	N7148.59	E6359.09	805.04	10.0
387	N7159.09	E6359.97	805.07	2.0
388	N7159.38	E6355.27	805.10	5.0
389	N7159.28	E6350.20	805.03	5.0
3810	N7156.94	E6349.98	804.86	4.0
3811	N7156.62	E6355.30	805.06	2.0
3812	N7159.23	E6347.91	805.06	3.0
3813	N7156.78	E6348.19	804.84	2.0
3814	N7154.50	E6348.27	804.80	2.0
3815	N7155.72	E6359.49	805.01	3.5
90301	N7156.10	E6341.10	804.82	4.0
90302	N7159.70	E6346.50	805.01	6.5
90303	N7155.20	E6351.60	804.99	4.5
90401	N6568.55	E5171.68	805.25	16.5
90402	N6640.70	E5078.90	804.98	16.5
90403	N6590.11	E5218.18	805.31	16.5

Note: All elevations are given in feet above mean sea level.

All wells were constructed so that the top of the screen was positioned approximately 2 feet above the saturated zone. Once the screen was positioned, the sand pack which consisted of 55-65 grade quartz sand, was slowly poured down the inside of the augers, until approximately 2 feet of sand filled the inside of the auger. The augers were slowly retracted, allowing the sand to settle into the auger hole. The sand pack was built up to a level of 2 feet above the top of the screen. Bentonite pellets were added above the sand pack, creating a seal which would stop infiltrating water. Finally, a Type 1 Portland cement/bentonite grout was added from the top of the bentonite seal to the ground surface.

After the monitoring well had been grouted to the surface, the PVC casing was cut approximately 2 feet above ground surface. The PVC casing was fitted with a locking cap. An 8-inch diameter protective steel casing with a locking lid was positioned over the PVC casing and grouted into place. Finally, three protective steel posts were positioned around the well.

Where well "stick-up" was a concern, a flush mount was constructed. For flush mount completion, the PVC casing was cut approximately 0.5 foot bgs. The 8-inch protective steel casing was then positioned around the PVC casing so that the top of this casing was a few inches below the ground surface. A protective casing (Christy Box), with locking cover installed flush with ground level, was placed around the PVC casing and the protective steel casing and grouted into place. This type of protective casing is used when above ground completion would hinder activities in the area. Cement was placed around the outside of the Christy Box.

3.5.3 Monitoring Well Development

The 15 auger-drilled monitoring wells were developed using a decontaminated 4-foot-long stainless-steel bailer and/or a TIMCO airlift pump. The procedure began by removing the PVC cap and monitoring the ambient air with the OVA. All data were recorded on well development sheets. Prior to beginning well development, water level and well depth, or depth to sediment,

were measured to the nearest hundredth of a foot. The measurements were taken using a Solinst water level detector. These data were used to calculate the water volume in the well. The wells were developed until a minimum of four well volumes of water were removed or the temperature, pH, and conductivity had stabilized using the following criteria: temperature, $\pm 0.5^{\circ}\text{C}$; pH, ± 0.1 units; and specific conductance, $\pm 10 \mu\text{mhos/cm}$ (unless the specific conductance was greater than $1,000 \mu\text{mhos/cm}$, in which case the value needed to be within 10% of the preceding value). Those wells with low recharge capacity due to properties of the formation, which were not able to meet the above criteria, were developed until dry. In those wells with a high recharge capacity, an air lift pump was used for development. This allowed fine-grained materials to be removed from the sand pack, as well as for stabilization of the development parameters. The water level and well depth were measured upon completion of development.

3.5.4 Slug Tests

Slug tests were performed on monitoring wells PG201, PG401, PG402, PG403, PG502, PG801, PG802, PG803, 4MW4, 5MW4, 8MW4, 8MW5, 8MW6, 8MW7, 8MW8, 9MW3, 9MW4, 9MW5, 9MW6, and 9MW7. A Hermit-10008 data logger recorded the data gathered on site. A pressure transducer was used in the well to measure changes in water level. A Solinst water level meter was used for initial sounding of the well. The slug used was a 6-foot by 1-inch rod. A slug this size will displace approximately 1.5 feet of water in a 2-inch diameter well.

All slug tests were performed on wells after their development. The procedure began by removing the PVC cap and monitoring the ambient air with the OVA. Static water level was measured to the nearest hundredth of a foot. The pressure transducer was then placed in the well and the water level was allowed to equilibrate to static water level. The reference water level on the data logger was set to a datum of 100.0 feet corresponding to the static water level. The slug was then placed in the well and again the water level was allowed to equilibrate. The slug was then rapidly pulled out of the well, causing the water level to drop quickly and then to rise to static water level.

The data logger recorded the changing water level at periodic time intervals from the time the slug was removed until static water level was achieved.

The operation of the Hermit 1000B provided for 10 different tests. Within each test were 5 different steps, each of which were used to record data from a single slug test.

The data were loaded from the Hermit-DM to Lotus 1-2-3 files on a IBM-PC compatible computer. The data were analyzed to determine hydraulic conductivities. Three different methods were used to analyze hydraulic conductivities: 1) the Bouwer and Rice (1976) method was used for the shallow wells screened primarily in the till, 2) the Papadopolus, et al. (1967) method was used for the deep wells screened primarily in the outwash, and 3) the Hvorslev method (Fetter, 1988) was used for all the wells. The data and analyses may be found in Appendix D. Analysis of slug tests assumes that the displaced water goes into the surrounding formation and therefore the recovery of the water is dependent on the properties of the formation. This assumption may not be valid if the diameter of the well is much smaller than that of the drilled hole, which has been backfilled with clean sand. In this case, a determination would be based on the hydraulic conductivity of the sand, rather than the formation.

3.6 SAMPLING PROGRAM

The field activities conducted and types of samples collected at each site are listed in Table 3-1. The procedures used for each sample method are presented in the following sections.

3.6.1 Sample Types and Methodology

3.6.1.1 Soil Sampling Using the Split Spoon Sampling Method

The following methodology was applied to soil sampling in the boreholes: The boreholes were drilled with 8- and 12-inch outer diameter (OD) augers. OVA

readings were taken every 5 feet. Split-spoon samples were taken every 5 feet, except when saturated sands heaving into the auger prevented the collection of a split-spoon sample that was representative of that interval. The samples were containerized in laboratory-cleaned glass sample jars with teflon-lined lids, labeled, and placed in ice packed coolers. Shelby tube samples were taken from intervals which showed the highest OVA readings or a soil/groundwater interface, or from samples which showed signs of unnatural discoloration. The ends of the tubes were sealed using melted paraffin. Samples were then transported to the field office where they were refrigerated until shipment. All data were recorded on borehole log forms.

3.6.1.2 Soil Sampling Using the Hand Auger Method

A total of 29 shallow soil samples were collected from a PCB spill site at the facility. The samples were typically collected as composite soils from 0 to 5 feet bgs. Sample locations were based on information gathered during the Phase I and Phase II, Stage 1 studies.

The equipment used for this soil sampling included: a decontaminated 3.5-inch by 6.0-inch stainless-steel hand bucket auger, a stainless-steel spoon, aluminum foil, and the OVA. The hole was advanced by augering the bucket auger into the soil. The OVA was used to monitor the ambient air to identify the presence of potentially hazardous gases emitted from the hole. Shallow soil samples were taken at specified intervals throughout the borehole. The samples were collected in glass jars and sealed with teflon-lined caps.

3.6.1.3 Monitoring Well Purging and Sampling

The newly installed monitoring wells were allowed to stabilize for a minimum of three days after development before samples were collected. Based on information gathered during the Stage 1 investigation, groundwater sampling proceeded from an area with low levels of contamination to areas with higher levels of contamination to minimize cross contamination between wells.

All data were recorded on well purging and sampling forms. OVA readings were taken from the top of the PVC casing in each monitoring well upon first removal of the well cap. Depth to water and total depth were then measured using the Solinst water level detector. These measurements were used to calculate the volume of water in the well and the required purging volume. All wells were purged with a 4-foot-long stainless-steel bailer. Monofilament nylon line was used to raise and lower the bailer from the well. The wells were purged until a minimum of three well volumes were removed and/or temperature, pH, and conductivity had stabilized, using the following criteria: temperature, $\pm 0.5^{\circ}\text{C}$; pH, ± 0.1 unit; and conductivity, ± 10 $\mu\text{mhos/cm}$. A preference was given to removing three well volumes although, when this was not possible due to low recharge capacity, the well was considered purged when the parameters had stabilized. Immediately after purging was completed, a second water level measurement was taken. At this point, the well was ready for sampling.

A 2-foot teflon bailer secured with monofilament nylon line was used to collect the groundwater samples. Samplers wore non-sterile surgical type gloves whenever handling the bailer or sample bottles. Sample bottle types, sizes, and appropriate preservations are listed in Table 3-4. Each sample bottle was rinsed thoroughly with sample water before being filled. The first bottles to be filled were those to be analyzed for volatile organics. The 40 ml vials had septum caps allowing them to be sealed leaving no head space. As a preservative, four drops of hydrochloric acid were placed in the vial prior to adding sample water. All other preservatives used were introduced after the bottle was filled. All sample jars were labeled with the following information: client and location, date and time sample, sample identification code, samplers' initials, analysis to be performed, site and sample location, and preservatives used. After all of the bottles for a sample had been filled, labeled, properly preserved, and sealed with tape, they were put into a cooler packed with ice. Electrical tape was used to seal the lids on the sample containers except in the case of the 40 ml VOA vials where the tape could be a possible source of contamination. Samples were packed and shipped in accordance with procedures outlined in the QAPP, Section 1.6.3.

Table 3-4. Sample Containers, Preservation Methods, and Holding Times

PARAMETER	CONTAINER MATERIAL	PRESERVATION	HOLDING TIME	METHOD
<u>Water</u>				
Halogenated Volatile Organics	Glass vial Teflon-lined Septa	4°C; 4 drops HCL	14 days	SW8010
Aromatic Volatile Organics	Glass vial Teflon-lined Septa	4°C; 4 drops HCL	14 days	SW8020
Semi-Volatile Organics	Amber glass Teflon cap liner	4°C	Extract 7 days; ana- lyze 40 days	SW8270
Total Dissolved Solids (TDS)	Plastic or glass	4°C	7 days	EPA 160.1
Metals (except Hg)	Plastic or glass	4°C; HNO ₃ to pH < 2	6 months	SW6010
Hg	Plastic or glass	4°C; HNO ₃ to pH < 2	38 days (glass) 13 days (plastic)	SW7470
Lead	Plastic or glass	HNO ₃ to pH < 2	6 months	SW7421
Common Anions	Plastic or glass	4°C	28 days	EPA 300
<u>Soil</u>				
Halogenated Volatile	Wide-mouth glass jar with teflon liner	4°C	14 days	SW8240
Aromatic Volatile Organics	Wide-mouth glass jar with teflon liner	4°C	14 days	SW8240
PCBs	Wide-mouth glass jar with teflon liner	4°C	Extract 14 days; analyze 40 days	SW8080
Metals (except Hg)	Wide-mouth glass jar with teflon liner	4°C	6 months	SW6010
Hg	Wide-mouth glass jar with teflon liner	4°C	28 days	SW7471
Lead	Wide-mouth glass jar with teflon liner	4°C	6 months	SW7420

3.6.1.4 Sediment Sampling

Five sediment samples were taken at the facility. Two were taken from Turkey Run and three were collected from Mason's Run. Two sample retrieving methods were employed. The first method was used where samplers could easily enter the stream. A stainless-steel spoon was used to scoop the sediments from the stream bed. Where the samplers could not easily enter the stream, a Ponar grab sampler was used. A Ponar grab is a clamshell-type scoop activated by a counter lever system. The shell is opened and latched in place and slowly lowered through overlying liquids to the depth of the sediment being sampled. When tension is released on the lowering cable, the latch releases and the lifting action of the cable on the lever system closes the clamshell. The sediments were retrieved from the Ponar and placed into a stainless-steel container where they were homogenized.

The sediments were then placed in glass jars and sealed with teflon-lined caps. When the jar was filled and capped, labeling was completed, noting the date and time of sample collection as well as sample number, sampler, chemical preservatives added, and the appropriate chemical parameters for analysis. The jars were then placed in an ice-packed cooler. After all the jars for one sampling suite had been filled, they were transported to the field office where they were refrigerated until shipment.

3.6.1.5 Surface Water Sampling

Surface water samples were collected at four locations at the facility. All samples collected were grab samples. Two samples were collected from Turkey Run and two from Mason's Run. Downstream samples were taken first, followed by the upstream samples, to create as little disturbance in the stream as possible.

After the sample bottles had been rinsed with stream water, the bottles were submersed just below the water surface of the stream being sampled. Sample bottles with septum caps were used to preserve samples to be analyzed

for volatile organics. Immediately after each bottle was filled and capped, labeling was completed, noting the date and time of sample collection as well as sample number, sampler, chemical preservatives added, and the appropriate chemical parameters for analysis. The bottles were then placed in an ice-packed cooler. After all the bottles for one sampling suite had been filled, they were transported to the field office where they were refrigerated until shipment. The only deviation from this sampling procedure was the way in which the volatile organic samples were handled. The preservative was put into the 40 ml glass vials prior to sampling. The lids were not taped because the adhesive on the tape could possibly contaminate the sample. Samples were packed and shipped in accordance with procedures outlined in the QAPP, Section 1.6.3.

3.6.1.6 Biological Sampling

An aquatic survey of Mason's Run was conducted on 7 October 1988. Two sites were sampled, including a site upstream of the facility and one downstream of the facility. Site selection criteria included: 1) the presence of natural substrates, 2) a water depth that would cover the hester-dendy samplers used to sample benthic communities (ca. 0.15 m), and 3) similar habitats between the upstream and downstream sites. The upstream portion of Mason's Run that was within the confines of the Plant (between the North Access Road and the point where Mason's Run goes underground) was located in a field. It had concrete banks except for a small segment near the point where Mason's Run goes underground, which was chosen to meet the site selection criteria stated above.

Mason's Run downstream of the AF Plant 85 had two potential sampling locations: a short segment upstream of Fifth Avenue and a segment between Fifth Avenue and a set of railroad tracks. The segment upstream of Fifth Avenue was not selected due to its concrete bottom and lack of natural substrate. The segment between Fifth Avenue and the railroad tracks, which was surrounded by woods, was selected as the second sampling location because it had a natural substrate, water depth adequate to cover the hester-dendy

samplers, and because it was not affected by any activities associated with the railroad.

During the sampling period (7 October 1988 through 11 November 1988), three sampling methods were used to assess the aquatic organisms. These included: 1) seining to determine if fish were present at the site and, if present, the numbers and species composition, 2) hester-dendy multiple plate samplers for benthic organisms that colonize, and 3) Ponar grab samples for benthic organisms inhabiting the substrates. Seining was done for a 15-minute period using a 6-foot wide seine (mesh size 1/8 inch). Ten hester-dendy samplers were used per site and the samplers were attached to 20-pound concrete patio blocks. At each site, two concrete blocks were used and on each block, 5 samplers attached using nylon ties. On 11 November 1988 the samplers were retrieved from Mason's Run and 6 of the 10 samplers were manually cleaned and sieved through a 40 mesh sieve. Even though only 6 hester-dendy samplers were needed, 10 samplers were placed in the field to provide insurance that, in the event some of the samplers became covered with sediments from storm events, at least 6 sediment-free samplers would be available for investigating colonizing benthic organisms. The organisms collected from the 6 randomly selected samplers were then preserved in 70% ethyl alcohol and identified to, at most, a generic level in the laboratory using keys from Pennak (1978), Parrish (1975), and Usinger (1956).

Five Ponar grab samples using a petite Ponar (6 inches x 6 inches) were collected at each site. These samples were processed at the time of collection in a fashion similar to those described above for the hester-dendy samplers.

3.6.1.7 Drum Sampling

The QAPP prescribed that all soil cuttings generated at the PCB spill site during the field sampling effort would be placed in a 55-gallon drum. At the end of the drilling phase of work, two composite samples were collected from the drum. The sample was collected using a decontaminated 4-foot stainless-steel bailer, stainless-steel spoon, and aluminum foil. The bailer was driven

into the cuttings in various sections of the drum where the soil collected in the bailer chamber. The soil was removed and homogenized.

3.6.2 Sample Preservation Methods, Required Containers, and Holding Times

Table 3-4 lists the sample type, preservative used, container used and required, and the holding times.

3.6.3 Quality Control Samples

Two types of quality control samples were prepared for water samples: field duplicates and blanks. One duplicate was randomly taken for every ten water samples collected. The samples were submitted as blind duplicate samples. This allowed for the precision of the laboratory to be tested. Three types of blanks were used to ensure that the sample collection and handling process had not affected the quality of the samples. Trip blanks were used on a frequency of one per shipping batch. These samples were transported to the sampling site and subsequently handled as a sample. Equipment blanks were used to ensure that the sampling devices were effectively decontaminated. Equipment blanks were issued one per each ten samples collected. One ambient condition blank was collected for this round of sampling. The sample bottles were filled at the site and handled as a sample. All blanks used ASTM Type II reagent water.

Replicate samples were prepared to fulfill quality control requirements for soil samples. Split-spoon samples were collected and divided into two equal parts for analysis. Sample numbers were adjusted to make field replicates indistinguishable from standard samples to personnel performing the analyses.

3.7 LABORATORY PROGRAM

3.7.1 Laboratory Identification

Brown and Caldwell Laboratories analyzed soil, sediment, surface water, and groundwater samples for the presence of organic and inorganic compounds.

3.7.2 Description of Laboratory Equipment

3.7.2.1 Gas Chromatograph/Mass Spectrometers (GC/MS), Methods 8240 and 8270

The seven GC/MS instruments include:

1. Two Finnigan 4000 series GC/MS systems interfaced with Data General Nova 4X computers and 70-megabyte Winchester disk drives, provide data acquisition, quantitation and reporting capabilities. Finnigan Software is available to produce EPA Contract Lab Program data reporting forms when required by project-specific DQOs. Streamer tape capability provides data archival ability. Both instruments are equipped with Tekmar volatile liquid sample concentrators. One instrument is equipped with a Tekmar ten-sample autosampler. Each instrument has packed and capillary column capability, while cryogenic oven cooling can meet specialized procedure needs.
2. One Finnigan INCOS-50 GC/MS with a Model 10/SP Data General desktop computer was used with a 70-megabyte Winchester drive, floppy disk and a 1/4-inch cipher cartridge tape drive data storage. The MS is interfaced with an HP 5890 GC and Tekmar's LSC 2000 and ALS 2016. The HP 5890 is configured to do both packed column and capillary column.
3. One Finnigan OWA/1050 GC/MS was interfaced with a Nova 4C computer utilizing a 70-megabyte Winchester disk drive for data collection. This system also employs 5.5 REV Superincos Finnigan software. A 1/4-inch cartridge tape drive is used for long-term data storage. The GC/MS instrument can be configured in capillary or packed column modes.
4. One Finnigan Model 5100EF GC/MS was interfaced with a Data General Nova 4X computer utilizing a 70-megabyte Winchester

disk drive and a 1/4-inch cartridge cipher tape drive for longer data storage. The 5100EF is equipped with a Model 8600 series auto-sampler.

5. One HP 5988A mass spectrometer is interfaced with an HP 5890 gas chromatograph and a 7673A autosampler, allowing automated capillary analysis of extractable compounds.
6. One HP 5970 MSD mass spectrometer and one 5890 gas chromatograph are interfaced with Tekmar 2000 Series liquid sample concentrator and autosampler modules, allowing automated volatile sample analysis. The 5970/ 5890 can be configured for either packed or capillary column operation. Cryogenic focusing of purged compounds and cryogenic oven cooling are used.

3.7.2.1.1 Frequency and Type of QA/QC, Method 8240. Instrument sensitivity is checked with BFB (p-bromofluorobenzene) every 12 hours of operation. Retention time, peak area and shape, and isotope ratios are examined. A mass calibration is then performed with perfluorotributylamine. The initial calibration of the GC/MS is conducted as necessary, using five concentrations. Response factors of five system performance check compounds (SPCCs) and six calibration check compounds (CCCs) are examined. The SPCC response factors must exceed 0.300 (except for bromoform at 0.250). The deviation of the CCC response factors from the average response factor must be less than 30%. A continuing calibration check is run every 12 hours. The SPCC response factors must meet the same criteria as in the initial calibration, and the CCC response factors may not deviate more than 25% from the average response factor of the initial calibration. Analysis may proceed if the SPCC and the CCC criteria are met for eight out of 11 compounds. The internal standard calibration method is used to quantitate samples.

3.7.2.1.2 Frequency and Type of QA/QC, Method 8270. Instrument sensitivity is checked with DFTPP (decafluorotriphenylphosphine) every 12 hours of operation. Retention time, peak area and shape, and isotope ratios are examined. A mass calibration is then performed with perfluorotributylamine. The initial calibration of the GC/MS is conducted as necessary, using five concentrations. Response factors of four system performance check compounds (SPCCs) and 13 calibration check compounds (CCCs) are examined. The SPCC

response factors must exceed 0.050. The deviation of the CCC response factors from the average response factor must be less than 30%. A continuing calibration check is run every 12 hours. The SPCC response factors must meet the same criteria as in the initial calibration, and the CCC response factors may not deviate more than 25% from the average response factor of the initial calibration. Analysis may proceed if the SPCC and CCC criteria are met for 13 out of 17 compounds. The internal standard calibration method is used to quantitate samples.

3.7.2.2 Gas Chromatographs (GC) Methods 8010 and 8020

Selective-detector gas chromatography is employed to solve a variety of analytical problems in which components of a general chemical class must be distinguished from background materials not having the class-specific properties. Of the more than 20 gas chromatographs currently in use in the laboratories, most are supplied by Hewlett Packard or Varian manufacturers.

1. Hewlett Packard GCs:

- Hewlett Packard 5890 with headspace autosampler (2)
- Hewlett Packard 5830 with HP 7672A autosampler
- Hewlett Packard 5840 with HP 7672A autosampler
- Hewlett Packard 5890 with Tekmar ALS/LSC-2
- Hewlett Packard 5880 with HP 7672A autosampler
- Hewlett Packard 5890 with HNU, PID, and ECD with Tekmar SD10 desorber
- Hewlett Packard 5890 with FID, ECD, and autosampler
- Hewlett Packard 5890 with FID, PID, and autosampler
- Hewlett Packard 5890 with Dual ECDs and autosampler.

2. Varian GCs:

- Varian 3700 with 8000 Model autosampler
- Varian 3400 with 8000 Model autosampler (2)
- Varian 3400 with 8034 Model autosampler
- Varian 3400 with purge and trap
- Varian 2700
- Varian 1400
- Varian 3400 with Tracor 700A hall detector and Tracor Model 703 PID
- Varian 3700

Varian 3400 with Tekmar ALS/LSC-2
Varian 3400 with HP headspace analyzer.

The GCs are equipped with a wide variety of detectors, including the following:

1. Flame ionization detector. Nonselective; for fuel fingerprinting and odor pattern matching.
2. Thermal conductivity detector. Nonselective; for analyzing methane, carbon dioxide, and other gases.
3. Electron capture detector. Moderately selective; for electron capturing components such as organo-chlorine pesticides, PCB, and phthalates.
4. Flame photometric detector. Selective; for phosphorus or sulfur-containing organics such as organo-phosphorus pesticides or sulfur gases.
5. Hall detector. When operated in the halogen mode, highly selective for compounds such as trihalomethanes and chlorinated solvents.
6. Photoionization detector. Selective; for photoionizable components such as aromatic solvents, esters, and unsaturates.

3.7.2.2.1 Frequency and Type of QA/QC, Methods 8010 and 8020. Initial calibration is performed with a minimum of three concentrations. The calibration curve must have a correlation factor of 0.990 or greater. Prior to running samples each day, a continuing calibration standard is run. The difference between the average response factor of the initial standard curve and the response factor of the continuing calibration must fall within the limits established by the method. The internal standard calibration method is used to quantitate samples.

3.7.2.3 Inductively Coupled Plasma Spectrometer (ICP), Method 6010

1. The Perkin-Elmer Plasma II inductively coupled plasma spectrometer is equipped with a Perkin-Elmer Model 7500 computer with color graphics for full automation of sample

processing and data handling. Supported with a PR210 dot-matrix color printer, the instrument is capable of determining up to 15 different trace metals in a single analysis.

2. The ARL Model 3410 inductively coupled plasma spectrometer is equipped with advanced software to maximize data handling. It is also capable of determining multiple elements in rapid sequence.

3.7.2.3.1 Frequency and Type of QA/QC, Method 6010. A calibration curve of three standards is run daily, prior to analysis of samples. Afterwards, a single standard is run every ten samples. The apparent concentration of this standard must lie within 10% of the true concentration. Standards are prepared by diluting mixed-element concentrates, which are themselves prepared from commercially available solutions. The concentrations of the commercial standards are checked quarterly against an EPA or NBS check solution.

3.7.2.4 Atomic Absorption Spectrophotometers, Methods 7420, 7421, 7470, 7060, and 7760

The seven instruments in use include Perkin Elmer models 5100, 5000, 3030, 2380 (2), 460, and 503, which are equipped to perform flame, graphite furnace, gaseous hydride, and cold vapor analyses. The PE 5100, 5000, and 3030 all have Zeeman background correction systems.

3.7.3 Laboratory QA/QC Program

Table 3-5 lists all of the method detection limits and control limits for all of the analytical parameters (except metals) sampled at AF Plant 85. Table 3-6 lists the method detection limits and control limits for metals.

**Table 3-5. Method Detection Limits and Control Limits
for Analytical Parameters (Except Metals) Sampled at AF Plant 85**

ANALYTICAL PARAMETERS	METHOD DETECTION LIMIT		QUALITY CONTROL SAMPLES CONTROL LIMITS SOIL/WATER (%)
	WATER	SOIL	
Total Dissolved Solids	10	mg/L	
Common Anions	0.5	mg/L	
PURGEABLE HALOCARBONS METHOD SM8010	ug/L	mg/kg	
Bis(2-Chloroisopropyl)ether	5	0.1	
Bromobenzene	5	0.1	
Bromodichloromethane	0.5	0.1	42 - 172
Bromoform	1	0.1	13 - 159
Bromomethane	6	0.1	D - 144
Carbon tetrachloride	0.6	0.1	43 - 143
Chlorobenzene	1.2	0.1	38 - 150
Chloroethane	3	0.1	46 - 137
Chloroform	0.2	0.1	49 - 133
1-Chlorohexane	5	0.1	
2-Chloroethyl vinyl ether	0.7	0.1	14 - 186
Chloromethane	0.4	0.1	D - 193
Chlorotoluene (total)	10	0.1	
Dibromochloromethane	0.5	0.1	24 - 191
Dibromomethane	5	0.1	
1,2-Dichlorobenzene	0.5	0.1	D - 208
1,3-Dichlorobenzene	1	0.1	7 - 187
1,4-Dichlorobenzene	0.5	0.1	42 - 143
Dichlorodifluoromethane	9	0.1	
1,1-Dichloroethane	0.4	0.1	47 - 132
1,2-Dichloroethane	0.2	0.1	51 - 147
1,1-Dichloroethene	0.7	0.1	28 - 167
trans-1,2-Dichloroethene	0.5	0.1	38 - 155
1,2-Dichloropropane	0.5	0.1	44 - 156
cis-1,3-Dichloropropene			22 - 178
trans-1,3-Dichloropropene	2	0.1	22 - 178
Methylene chloride	2	0.1	25 - 162
1,1,1,2-Tetrachloroethane	5	0.1	
1,1,2,2-Tetrachloroethane	0.2	0.1	8 - 184
Tetrachloroethene	0.2	0.1	26 - 162
1,1,1-Trichloroethane	0.5	0.1	41 - 138
1,1,2-Trichloroethane	0.5	0.1	39 - 136
Trichloroethene	0.6	0.1	35 - 146
Trichlorofluoromethane	5	0.1	21 - 156
Trichloropropane	5	0.1	
Vinyl chloride	0.6	0.1	28 - 163

**Table 3-5. Method Detection Limits and Control Limits
for Analytical Parameters (Except Metals) Sampled at AF Plant 85 (Continued)**

ANALYTICAL PARAMETERS	METHOD DETECTION LIMIT		QUALITY CONTROL SAMPLES CONTROL LIMITS SOIL/WATER (%)
	WATER	SOIL	
PURGEABLE AROMATIC VOLATILES METHOD SW5030/SW8020	ug/L	mg/kg	
Benzene	0.7	0.2	39 - 150
Chlorobenzene	1	0.2	55 - 135
1,2-Dichlorobenzene	2	0.2	37 - 154
1,3-Dichlorobenzene	2	0.2	50 - 141
1,4-Dichlorobenzene	0.5	0.2	42 - 143
Ethylbenzene			32 - 160
Toluene	1	0.2	46 - 148
Xylenes	2	0.2	
ORGANOCHLORINE PESTICIDES (PCBs) METHOD SW3510/SW8080(W) SW3550/SW8080(S)	ug/L	mg/kg	
Aroclor-1260	1	0.2	8 - 127
SEMIVOLATILE ORGANIC COMPOUNDS METHOD SW3510/8270(W) SW3550/8270(S)	ug/L	mg/kg	
Acenaphthene	10	0.5	47 - 145
Acenaphthylene	50	2.5	33 - 145
Acetophenone	50	2.5	
Aniline	50	2.5	
Anthracene	10	0.5	27 - 133
Benzidine	50	2.5	
Benzo(a)anthracene	10	0.5	33 - 143
Benzo(b)fluoranthene	10	0.5	24 - 159
Benzo(k)fluoranthene	10	0.5	11 - 162
Benzo(ghi)perylene	10	0.5	0 - 219
Benzo(a)pyrene	10	0.5	17 - 163
Benzylbutylphthyl Ether			12 - 158
Benzyl alcohol	20	1.0	
bis(2-Chloroethoxy)methane	10	0.5	33 - 184
bis(2-Chloroethyl)ether	10	0.5	
bis(2-Chloroisopropyl)ether	10	0.5	36 - 166
bis(2-ethylhexyl)phthalate	10	0.5	8 - 158
4-Bromophenyl phenyl ether	10	0.5	53 - 127
Butyl benzyl phthalate	10	0.5	
4-Chloroaniline	20	1.0	
1-Chloronaphthalene	50	2.5	

**Table 3-5. Method Detection Limits and Control Limits
for Analytical Parameters (Except Metals) Sampled at AF Plant 85 (Continued)**

ANALYTICAL PARAMETERS	METHOD DETECTION LIMIT		QUALITY CONTROL SAMPLES CONTROL LIMITS SOIL/WATER (%)
	WATER	SOIL	
SEMIVOLATILE ORGANIC COMPOUNDS (Cont'd.)			
2-Chloronaphthalene	10	0.5	60 - 118
4-Chlorophenyl phenyl ether	10	0.5	25 - 158
Chrysene	10	0.5	17 - 168
Dibenz(a,j)acridine	50	2.5	
Dibenzo(a,h)anthracene	10	0.5	D - 227
Dibenzofuran	10	0.5	
Di-n-butylphthalate	10	0.5	1 - 118
1,2-Dichlorobenzene	5	0.5	32 - 129
1,3-Dichlorobenzene	5	0.5	D - 172
1,4-Dichlorobenzene	5	0.5	20 - 124
3,3'-Dichlorobenzidine	20	0.5	D - 262
Diethyl phthalate	20	0.5	D - 114
7,12-Dimethylbenz(a)anthracene	50	2.5	
Dimethyl phthalate	10	0.5	D - 112
2,4-Dinitrotoluene	10	0.5	39 - 139
2,6-Dinitrotoluene	10	0.5	50 - 158
Diphenylamine	50	0.5	
1,2-Diphenylhydrazine	50	2.5	
Di-n-octyl phthalate	10	0.5	4 - 156
Fluoranthene	10	0.5	26 - 137
Fluorene	10	0.5	
Hexachlorobenzene	10	0.5	D - 152
Hexachlorobutadiene	10	0.5	24 - 116
Hexachlorocyclopentadiene	10	0.5	
Hexachloroethane	10	0.5	40 - 113
Indeno(1,2,3-cd)pyrene	10	0.5	D - 171
Isophorone	10	0.5	21 - 196
3-Methylcholanthrene	50	2.5	
2-Methylnaphthalene	10	0.5	
Naphthalene	10	0.5	21 - 133
2-Nitroaniline	50	2.5	
3-Nitroaniline	50	2.5	
4-Nitroaniline	50	2.5	
Nitrobenzene	10	0.5	35 - 180
n-Nitrosodimethylamine	50	2.5	
n-Nitrosodiphenylamine	10	0.5	
n-Nitrosodi-n-propylamine	10	0.5	D - 230
Pentachlorobenzene	50	2.5	
Pentachloronitrobenzene	50	2.5	

**Table 3-5. Method Detection Limits and Control Limits
for Analytical Parameters (Except Metals) Sampled at AF Plant 85 (Continued)**

ANALYTICAL PARAMETERS	METHOD DETECTION LIMIT		QUALITY CONTROL SAMPLES CONTROL LIMITS SOIL/WATER (%)
	WATER	SOIL	
SEMIVOLATILE ORGANIC COMPOUNDS (Cont'd.)			
Phenanthrene	10	0.5	54 - 120
Pyrene	10	0.5	52 - 115
1,2,4,5-Tetrachlorobenzene	50	2.5	
1,2,4-Trichlorobenzene	10	0.5	44 - 142
Benzoic acid	50	2.5	
4-Chloro-3-methylphenol	10	0.5	22 - 147
2-Chlorophenol	10	0.5	23 - 134
2,4-Dichlorophenol	10	0.5	39 - 135
2,6-Dichlorophenol	50	2.5	
2,4-Dimethylphenol	10	0.5	32 - 119
2-Methyl-4,6-dinitrophenol	50	1.5	D - 181
2,4-Dinitrophenol	50	1.5	D - 191
2-Methylphenol	10	0.5	
4-Methylphenol	10	0.5	
2-Nitrophenol	10	0.5	29 - 182
4-Nitrophenol	50	2.5	D - 132
Pentachlorophenol	30	1.5	14 - 176
Phenol	10	0.5	5 - 112
2,3,4,6-Tetrachlorophenol	50	2.5	
2,3,5-Trichlorophenol	50	1.5	
2,4,6-Trichlorophenol	10	0.5	37 - 144
VOLATILE ORGANIC COMPOUNDS (VOCs) METHOD SW8240			
	ug/L	mg/kg	
Acetone	50	6.3	
Acrolein	10	1.3	
Acrylonitrile	10	1.3	
Benzene	3	0.4	37 - 151
Bromodichloromethane	5	0.6	35 - 155
Bromoform	5	0.6	45 - 169
Bromomethane	10	1.3	D - 242
2-Butanone	50	6.3	
Carbon disulfide	5	0.6	
Carbon tetrachloride	3	0.4	70 - 140
Chlorobenzene	5	0.6	37 - 160
Chlorodibromomethane	5	0.6	
Chloroethane	10	1.3	

**Table 3-5. Method Detection Limits and Control Limits
for Analytical Parameters (Except Metals) Sampled at AF Plant 85 (Continued)**

ANALYTICAL PARAMETERS	METHOD DETECTION LIMIT		QUALITY CONTROL SAMPLES
	WATER	SOIL	CONTROL LIMITS SOIL/WATER (%)
VOLATILE ORGANIC COMPOUNDS (VOCs) (Cont'd.)			
2-Chloroethyl vinyl ether	10	1.3	D - 305
Chloroform	5	0.6	51 - 138
Chloromethane	10	1.3	D - 273
Dibromomethane	10	1.3	
Dibromochloromethane			53 - 149
Dichlorodifluoromethane	10	1.3	
1,2-Dichlorobenzene			18 - 190
1,3-Dichlorobenzene			59 - 156
1,4-Dichlorobenzene			18 - 190
1,1-Dichloroethane	5	1.6	59 - 155
1,2-Dichloroethane	3	0.4	49 - 155
1,1-Dichloroethene	3	0.4	D - 234
trans-1,2-Dichloroethene	5	0.6	54 - 156
1,2-Dichloropropane	5	0.6	D - 210
cis-1,3-Dichloropropene	5	0.6	D - 227
trans-1,2-Dichloropropene	5	0.6	17 - 183
Ethylbenzene	5	0.6	37 - 162
2-Hexanone	50	6.3	
Iodomethane	10	1.3	
Methyl chloride	5	0.6	D - 221
4-Methyl-2-pentanone (MIBK)	50	6.3	
Styrene	5	0.6	
1,1,2,2-Tetrachloroethane	5	0.6	46 - 157
Tetrachloroethene	3	0.4	64 - 148
Toluene	5	0.6	47 - 150
1,1,1-Trichloroethane	5	0.6	52 - 162
1,1,2-Trichloroethane	5	0.6	52 - 150
Trichloroethene	3	0.4	71 - 157
Trichlorofluoromethane	10	1.3	17 - 181
Vinyl acetate	50	6.3	
Vinyl chloride	10	1.3	D - 251
Xylenes (total all isomers)	10	1.3	

D = Detection Limit

Table 3-6. Method Detection Limits and Control Limits
for Analytical Parameters (Metals) Sampled at AF Plant 85

ANALYTICAL PARAMETERS	METHOD DETECTION LIMITS		QUALITY CONTROL SAMPLES CONTROL LIMITS		LABORATORY CONTROL STANDARDS CONTROL LIMITS	
	WATER (mg/L)	SOIL (mg/kg)	WATER (%)	SOIL (%)	WATER/SOIL (%)	
Arsenic	0.005	----				
Lead	0.005					
Mercury	0.001	0.5				
Selenium	0.005	----				
METALS SCREEN SW3005/6010						
Aluminum	0.2	20		Insuff. Data		90-110
Antimony	1.0	20		58.2-118.2 D-120.7		
Arsenic	0.3	30		Insuff. Data		
Barium	0.1	10		68.8-122.1 37.8-151.0		90-110
Beryllium	0.01	0.02		82.0-115.8 70.9-119.6		90-110
Cadmium	0.06	2		Insuff. Data 55.5-113.7		90-110
Calcium	5	500		Insuff. Data		90-110
Chromium	0.04	4		68.2-123.2 59.7-117.6		90-110
Cobalt	0.05	4		56.0-120.0 46.4-124.8		90-110
Copper	0.04	3		75.0-111.6 73.5-119.1		90-110
Iron	0.04	4		59.3-139.9 Insuff. Data		90-110
Lead	0.4	20		Insuff. Data 61.3-120.2		90-110
Magnesium	5	500		63.4-121.4 Insuff. Data		90-110
Manganese	0.01	1		71.9-124.1 Insuff. Data		90-110
Molybdenum	0.2	4		39.5-122.2 39.4-116.8		90-110
Nickel	0.05	4		74.8-113.6 66.6-111.6		90-110
Potassium	5	500		77.8-111.2 Insuff. Data		90-110
Selenium	0.4	40				
Silver	0.06	3				
Sodium	5	500		66.0-128.5 Insuff. Data		90-110
Thallium	0.5	50		54.2-124.7 41.9-129.7		90-110
Vanadium	0.04	4		78.4-111.0 53.7-121.7		90-110
Zinc	0.04	1		76.8-115.7 63.8-122.9		90-110

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4.0 RESULTS AND SIGNIFICANCE OF FINDINGS

4.1 DISCUSSION OF RESULTS

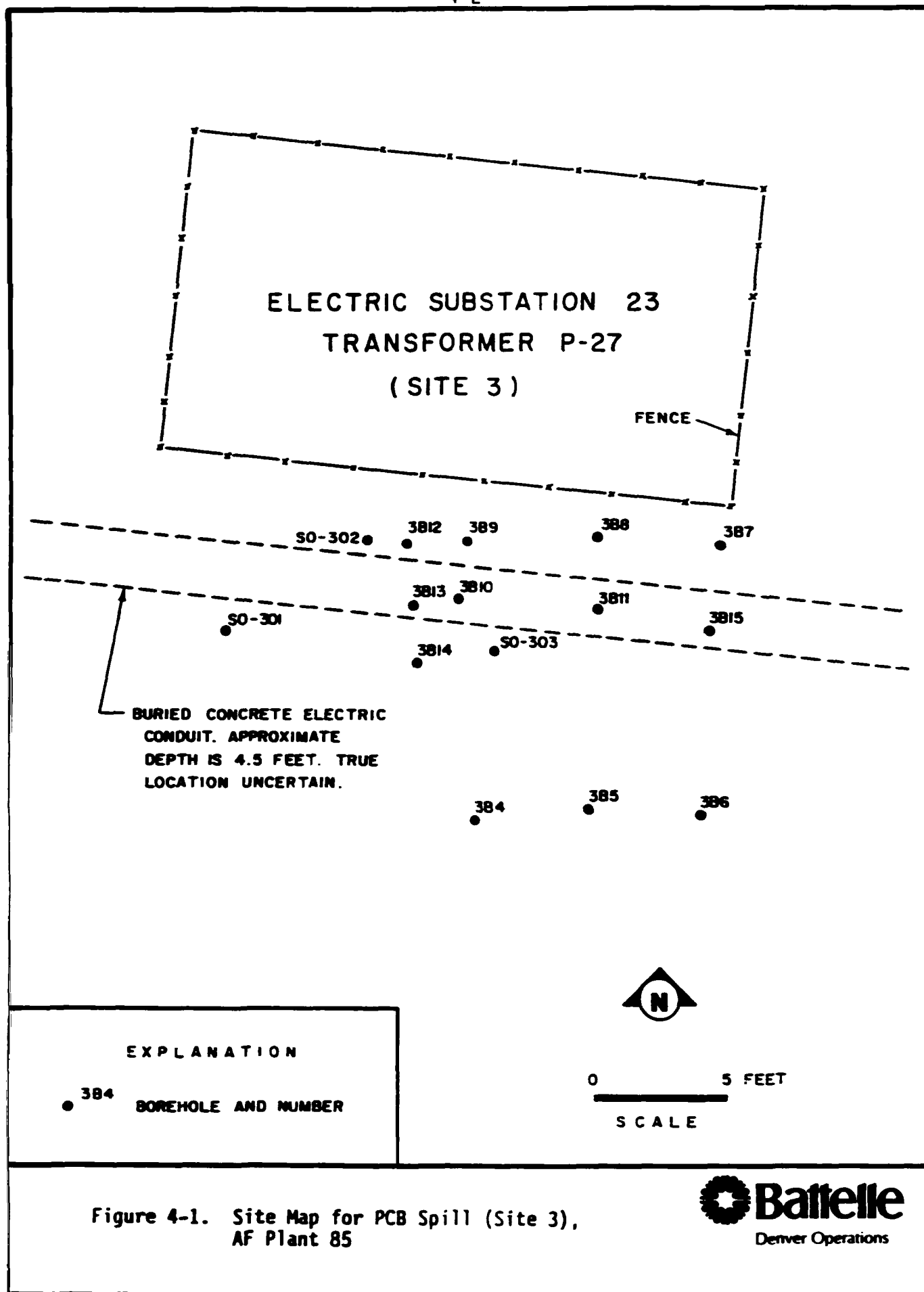
4.1.1 Discussion of Results for PCB Spill Site (Site 3)

Site 3 is the location of a PCB spill which occurred near Substation 23, Transformer P-27, located in the north central part of AF Plant 85 (Figure 4-1). In January 1983, a drain valve malfunctioned, resulting in several gallons of transformer oil leaking out onto a concrete pad and the soil apron on the south side of the substation (CH2M HILL, 1984). An apron of gravel underlain with natural soil or fill exists between the transformer's concrete foundation and the enclosing chain link fence. The integrity of the platform is unknown.

The area was excavated on two separate occasions after the occurrence of the spill. However, no documentation is available defining the exact dimensions of the excavated area or when the excavation occurred; and it is unknown if the area between the transformer foundation and fence was excavated. The excavated area was backfilled to grade; the origin of the fill is not known.

Buried concrete conduits are located roughly 2.5 feet south of the fence and run parallel to the fence line. The conduits were encountered during the field investigations at approximately 4.5 feet bgs.

Sampling strategy for Phase II, Stage 1 and RI/FS, Stage 2 investigations involved the collection of soil samples for chemical analysis. During Stage 1, soil samples from three hand-augered boreholes were retrieved. Three samples were collected from each boring. One sample was obtained at ground surface, one was taken at a depth of approximately 2.5 feet (the total depth of the boreholes depended upon whether any obstruction was encountered while drilling), and the third was taken at the bottom of the hole. Stage 2 sampling was designed to verify the results from Stage 1 and to define the areal extent of PCB-contaminated soil. This included drilling three additional boreholes with a CME-55 auger rig and retrieving split-spoon soil samples. Samples from these boreholes were taken at intervals of 1 to 2.5, 3.5 to 5.0, 6.0 to 7.5,



and 8.5 to 10 feet. These boreholes were located 12.5 feet from the fence line and did not encounter the concrete conduits. Soil samples were also collected from nine hand-augered holes located within 7.0 feet of the fence. Soil samples were taken at various depths from the hand-augered holes, the depths of which were controlled by the depth to the concrete conduit.

4.1.1.1 Presentation of Results

4.1.1.1.1 Site Geology/Hydrology. Borehole logs completed at the site show a mixture of sand and clay in varying proportions in the undisturbed areas and with more sand where fill material was used. The mixture of the sand and clay was moist in the upper 6 feet but was hard and dry at approximately 10 feet, characteristic of the glacial till in this area.

Several of the hand-augered boreholes filled with water when left open overnight. This shallow, slow-recharging, water-bearing zone reaches its highest level in early spring and its lowest level in the fall, being recharged primarily by infiltration from precipitation and possibly also from nearby Mason's Run.

4.1.1.1.2 Analytical Results. Nine soil samples were collected during the Stage 1 investigation and 26 during Stage 2. The samples were analyzed for the presence of PCBs only. The results from both Stages 1 and 2 are presented in Tables 4-1 and 4-2. The percent moisture content for the Stage 1 samples was not provided by the laboratory, so these PCB concentrations are presented in wet weights rather than dry weights. (This information has been requested from PEI Laboratories.) The borehole locations and PCB concentrations from Stages 1 and 2 are illustrated at various depths in Figure 4-2. Duplicate values are shown in parentheses.

Of the many types of PCBs, only Aroclor 1260 was found at Site 3. Aroclor 1260 concentrations in soil samples ranged from 0.85 to 422 mg/kg during Stage 1 and 0.06 to 700 mg/kg during Stage 2.

Table 4-1
ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT PCB SPILL
SITE (SITE 3) DURING PHASE II, STAGE 1, AF PLANT 85
(Continued)

Parameter	Method	Units	Detection Limit	Federal State	Standards and Action Levels*	Sample Type	Site			Date Coll.	Field No.	Lab No.
							Station	Depth	Sample Type			
							SO 302	5.0	Dup 3006	1/9/86	GS-86-3007	FG-859
							SO 303	0.0	1/9/86	1/9/86	GS-86-3008	FG-857
							SO 303	2.5	1/9/86	1/9/86	GS-86-3009	FG-858
							SO 303	4.0	1/9/86	1/9/86	GS-86-3009	FG-858
Cadmium	SW 7130	mg/kg	0.2									
Chromium	SW 7210	mg/kg	0.0001									
Lead	SW 7420	mg/kg	0.000									
Nickel	SW 7320	mg/kg	0.002									
Oil and Grease	E 413.2	mg/kg	NA									
1,1-Dichloroethane	SW 8010	mg/kg	0.0044									
1,2-Dichloroethane	SW 8010	mg/kg	0.0044									
Methylene chloride	SW 8010	mg/kg	0.0044									
Tetrachloroethylene	SW 8010	mg/kg	0.0044									
Trans-1,2-Dichloroethylene	SW 8010	mg/kg	0.0044									
1,1,1-Trichloroethane	SW 8010	mg/kg	0.0044									
Trichloroethylene	SW 8010	mg/kg	0.0049									
Toluene	SW 8020	mg/kg	0.0034									
Aroclor 1260	SW 8000	mg/kg	NA	50.00	50.00		422	147	9.76	9.39	0.85	
Moisture in soil **		Percent										

* = Where no values are given, parameter is not regulated.

— = Sample not analyzed for this parameter.

NA = Not Available.

** = Percent moisture currently not available; results are presented on a wet-weight basis.

TABLE 4-2
ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT PCB SPILL SITE
(SITE 3) DURING RI/FS, STAGE 2, AF PLANT 06

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels ----- Federal State	Site Station Depth Sample Type Date Coll. Field No. Lab No.	3 04 3.5-5.0 10/29/00 005-SO-003-001 00103430.1	3 04 3.5-5.0 10/29/00 005-SO-003-002 00103430.2	3 04 0.0-7.5 10/29/00 005-SO-003-003 00103430.3	3 04 0.5-10.0 10/29/00 005-SO-003-004 00103430.4	3 05 1.0-2.5 10/29/00 005-SO-003-005 00103430.5	3 05 1.0-2.5 10/29/00 005-SO-003-006 00103430.6
Aroclor 1200	EPA 8000	ug/kg	0.03	50.0 50.0		0.37	ND	0.00	ND	0.1	ND
Total PCBs	EPA 8000	ug/kg		50.0 50.0		0.37		0.00		0.1	
Moisture in soil		Percent				14	17	13	10	10	10
Parameter	Method	Units	Method Detection Limit	Standards and Action Levels ----- Federal State	Site Station Depth Sample Type Date Coll. Field No. Lab No.	3 05 0.0-7.5 10/29/00 005-SO-003-007 00103430.7	3 05 0.5-10.0 10/29/00 005-SO-003-008 00103430.8	3 05 1.0-2.5 10/29/00 005-SO-003-009 00103430.9	3 05 3.5-5.0 10/29/00 005-SO-003-010 00103430.7	3 05 0.0-7.5 10/29/00 005-SO-003-011 00103430.8	3 05 0.5-10.0 10/29/00 005-SO-003-012 00103430.9
Aroclor 1200	EPA 8000	ug/kg	0.03	50.0 50.0		ND	ND	0.1	ND	ND	ND
Total PCBs	EPA 8000	ug/kg		50.0 50.0				0.1			
Moisture in soil		Percent				21	12	14	16	10	9
Parameter	Method	Units	Method Detection Limit	Standards and Action Levels ----- Federal State	Site Station Depth Sample Type Date Coll. Field No. Lab No.	3 05 0.0-7.5 10/29/00 Dup 005-007 005-SO-003-013 00103430.9	3 05 0.5-10.0 10/29/00 Dup 005-012 005-SO-003-014 00103430.10	3 07 1.0-2.0 10/27/00 005-SO-003-015 00104000.1	3 08 1.0-2.0 10/27/00 005-SO-003-016 00104000.2	3 08 4.0-5.0 10/27/00 005-SO-003-017 00104000.3	3 08 1.0-2.0 10/27/00 005-SO-003-018 00104000.4
Aroclor 1200	EPA 8000	ug/kg	0.03	50.0 50.0		ND	ND	4	0.00	1.0	700
Total PCBs	EPA 8000	ug/kg		50.0 50.0				4	0.00	1.0	700
Moisture in soil		Percent				19	9	10	10	10	20

ND = Not detected.

-- = Sample not analyzed for this parameter.

TABLE 4-2

ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT PCB SPILL SITE
(SITE 3) DURING RI/FS, STAGE 2, AF PLANT 06
(Continued)

Parameter	Method	Units	Method Detection Limit	Site				Standards and Action Levels				Method Detection Limit			
				Federal	State	Lab No.	Field No.	Date Coll.	Sample Type	Depth	Station	Federal	State	Lab No.	Field No.
Aroclor 1260	EPA 8080	mg/kg	0.03	50.0	50.0	230	010	10/27/88	1.0-2.0	B10	3	50.0	50.0	230	010
Total PCBs	EPA 8080	mg/kg		50.0	50.0	230	010	10/27/88	1.0-2.0	B10	3	50.0	50.0	230	010
Moisture in soil		Percent				17	20	10/27/88	1.0-2.0	B10	3			17	20
Parameter	Method	Units	Method Detection Limit	Site				Standards and Action Levels				Method Detection Limit			
				Federal	State	Lab No.	Field No.	Date Coll.	Sample Type	Depth	Station	Federal	State	Lab No.	Field No.
Aroclor 1260	EPA 8080	mg/kg	0.03	50.0	50.0	24	370	10/28/88	1.0-2.0	B12	3	50.0	50.0	24	370
Total PCBs	EPA 8080	mg/kg		50.0	50.0	24	370	10/28/88	1.0-2.0	B12	3	50.0	50.0	24	370
Moisture in soil		Percent				22	22	10/28/88	1.0-2.0	B12	3			22	22
Parameter	Method	Units	Method Detection Limit	Site				Standards and Action Levels				Method Detection Limit			
				Federal	State	Lab No.	Field No.	Date Coll.	Sample Type	Depth	Station	Federal	State	Lab No.	Field No.
Aroclor 1260	EPA 8080	mg/kg	0.03	50.0	50.0	10	0.15	10/28/88	1.0-2.0	B16	3	50.0	50.0	10	0.15
Total PCBs	EPA 8080	mg/kg		50.0	50.0	10	0.15	10/28/88	1.0-2.0	B16	3	50.0	50.0	10	0.15
Moisture in soil		Percent				14	20	10/28/88	1.0-2.0	B16	3			14	20

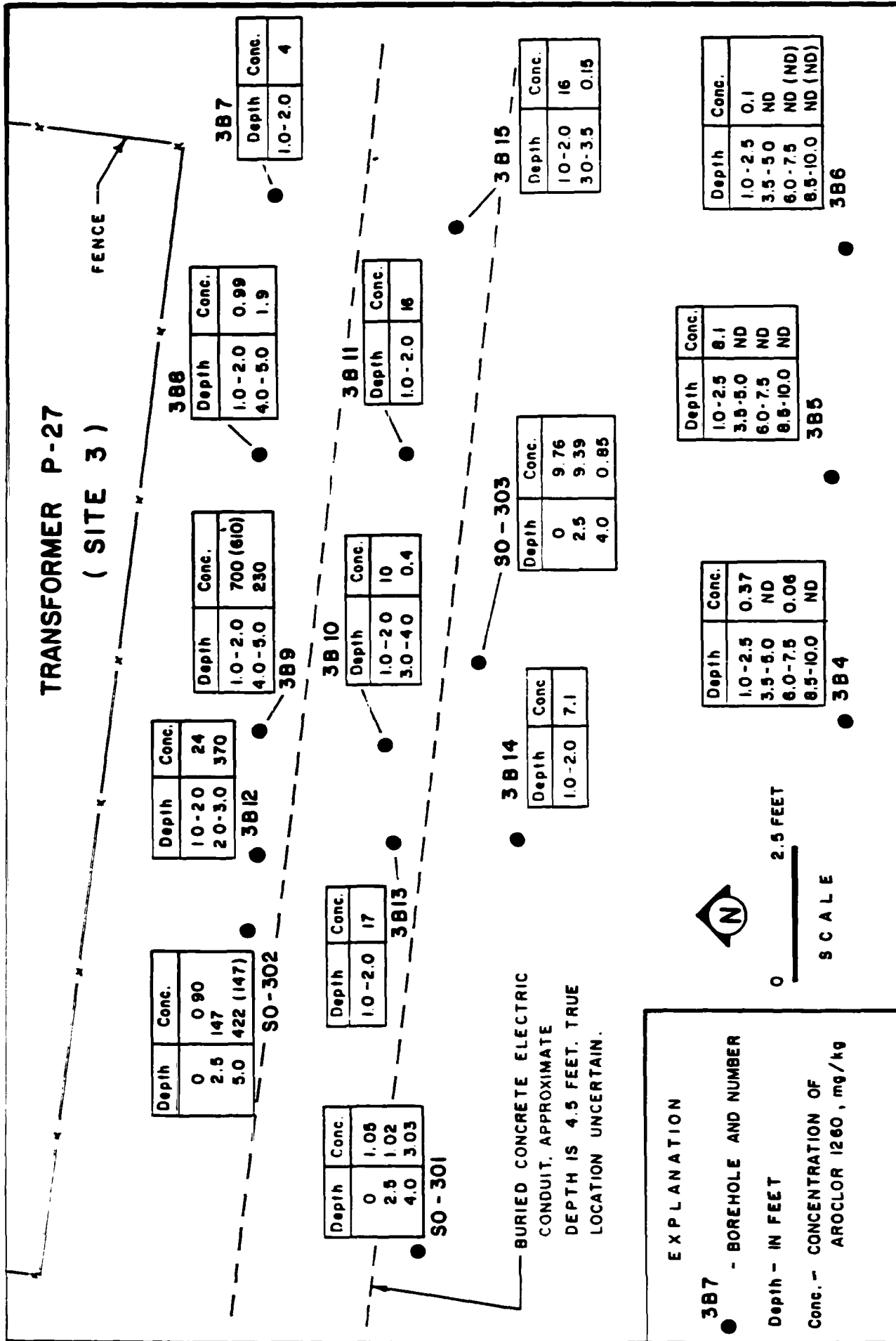


Figure 4-2. Distribution of PCB concentrations at Site 3.

4.1.1.2 Sampling or Analytical Problems

A total of 29 soil samples were collected and submitted for analysis for PCBs. Of the 29 samples, three were submitted as duplicates. The relative percent difference (RPD) ranged from 0 to 3.4%. The RPD measures the precision of the data. A 3.4% RPD indicates very good precision and that there were no analytical problems. The only sampling problem experienced during the collection of these samples was the obstruction caused by the underground electrical conduits. A full horizontal profile could not be developed, which limits the reliability of determining the soil volume contaminated with PCBs.

4.1.1.3 Significance of Findings

The action level provided for PCBs by 40 CFR Part 761 I is 50 ppm or greater concentration of PCBs. During the Stage 1 sampling effort, three out of the ten soil samples contained Aroclor 1260 exceeding this 50 ppm federal action level; in Stage 2, four of the 29 soil samples exceeded this level.

The 40 CFR Part 761 IV, C2b provides cleanup standards for PCBs in soil: "At the option of the responsible party, soil contaminated by the spill will be cleaned: (1) To 25 ppm (mg/kg) PCBs by weight, or (2) to 50 ppm (mg/kg) PCBs by weight provided that a label or notice is visibly placed in the area." The 25 ppm cleanup standard was agreed to by the AF Plant 85 Technical Program Manager (TPM) from HSD/YAQI for use in remedial planning. Ohio regulations parallel the federal regulations as established in 40 CFR Part 761.

4.1.1.3.1 Zones of Contamination. The highest concentrations were found in boreholes 3B9 and S0302, next to the fence, and decreased moving south, away from the fence in boreholes 3B4, 3B5, and 3B6. The soil closest to the fence appears to have been contaminated with most of the oil to a depth of at least 4 feet, where concentrations begin to diminish (from 700 to 230 mg/kg in 3B9). Prior excavation of the area nearest to the fence reached a depth of roughly 2 feet. PCBs were detected here from 1 to 5 feet deep during the Stage 1 sampling effort. Away from the fence line, PCBs have been detected from 1 to

4 feet deep. Previous excavation of this area appears not to have gone deep enough to remove all of the PCB-contaminated soil.

4.1.1.3.2 Contaminant Migration. PCB migration through soil is possible. Runoff from the concrete pad during precipitation events would increase the amount of water for infiltration. This would contribute to the seepage of PCBs through the soil media which may be responsible for the presence of the compound at depths greater than 2.5 feet.

Airborne migration, although unlikely, could account for the distribution of the compound at shallow depths, less than 2.5 feet, in soils 10 feet away from the areas of highest contamination.

Migration of PCBs in the groundwater is not likely due to the properties of PCBs, which are discussed in the following subsection, and to the hydraulic conductivity of the water-bearing zone, which is estimated at between 10^{-4} and 10^{-10} cm/sec (Freeze and Cherry, 1979). The wide range of hydraulic conductivities results from the heterogeneity of glacial till materials. Sieve analysis performed on till material indicates that more than 70% of the grains are silt- to clay-sized particles. This is substantiated by the results of permeability tests performed on soil samples collected from the till elsewhere at the AF Plant 85 facility, which yielded results between 1.73×10^{-6} and 6.5×10^{-8} cm/sec. This would indicate a hydraulic conductivity in the lower range, 10^{-6} to 10^{-8} cm/sec.

4.1.1.3.3 Baseline Risk Assessment. A baseline risk assessment was performed on PCBs to indicate the risk to human health and the environment from the presence of this contaminant at Site 3.

Waste Characterization. PCBs are a complex mixture of chemicals composed of two connected benzene rings with 1 to 10 chlorine atoms attached. The physical, chemical, and fate data for the compound are presented on Table 4-3. The half-lives of these compounds in various media are also given on Table 4-4. The fate data include Henry's Law Constant, Organic Carbon Partition Coefficient

Table 4-3. Physical, Chemical, and Fate Data

Chemical Name	CAS #	Mole Weight (g/mole)	Water Solubility (mg/l)	Vapor Pressure (mm Hg)	Henry's Law Constant (atm-m ³ /mole)	Koc (ml/g)	Log Kow	Fish BCF (l/kg)
Benzo(a)pyrene	50-32-8	252	1.20E-03	5.60E-09	1.55E-06	5500000	6.06	NA
PCBs	1136-36-3	328	3.10E-02	7.70E-05	1.07E-03	530000	6.04	100000
TCE	79-01-6	131	1.10E+03	5.79E+01	9.10E-03	126	2.38	10.6
Freon 113	76-13-1	187	1.00E+01	2.70E+02	NA	NA	2.00	NA

Source: SPHEM, 1986

Table 4-4. Half Lives in Various Media (Days)

Chemical Name	CAS #	Soil		Air		Surface Water		Groundwater	
		Low	High	Low	High	Low	High	Low	High
Benzo(a)pyrene	50-32-8	420.00	480.00	1.00	6.00	0.40	NA	NA	NA
PCBs	1336-36-3	NA	NA	58.00	NA	2.00	12.90	NA	NA
TCE	79-01-6	NA	NA	3.70	NA	1.00	90.00	NA	NA
Freon 113	76-13-1	NA	NA	NA	NA	NA	NA	NA	NA

Source: SPHEM, 1986

NA = Not Available

(K_{OC}), the Log Octanol-Water Partition Coefficient (K_{OW}), and Bioconcentration Factor [Superfund Public Health Evaluation Manual (SPHEM), 1986].

Henry's Law Constant (H) is a parameter important in evaluating air exposure pathways and is measured in terms of vapor pressure ($\text{atm}\cdot\text{m}^3/\text{mole}$). It is an expression of the distribution of the chemical between air and water at equilibrium. H is appropriately used for estimating releases to the air from contaminated water and should be used to evaluate chemicals for which this pathway is present. In general, the greater the number, the higher is the potential for the compound to volatilize into the atmosphere. H for PCBs is $1.07 \times 10^{-3} \text{ atm}\cdot\text{m}^3/\text{mol}$, indicating a moderate potential for release of these compounds into the atmosphere from water.

The Organic Carbon Partition Coefficient (K_{OC}) is a measure of the tendency for organics to be adsorbed by soil and sediment; it is measured in terms of ml/g. The K_{OC} is chemical-specific and is largely independent of soil properties. The normal range of K_{OC} values is from 1 to 10^7 , with higher values indicating greater sorption potential. The K_{OC} value for PCBs is $5.3 \times 10^5 \text{ ml/g}$, indicating a high affinity for soils.

The Octanol-Water Partition Coefficient (K_{OW}) is a measure of how a chemical is distributed at equilibrium between octanol and water. It is used often in the assessment of environmental fate and transport for organic chemicals. The log of K_{OW} is sometimes used and is shown on Table 4-3 as 6.04 for PCBs. A high value for K_{OW} indicates that the compound is readily soluble in octanol and exhibits relatively low water solubility.

The Bioconcentration Factor as used in this table is a measure of the tendency for a chemical contaminant in water to accumulate in fish tissue. The equilibrium concentration of a contaminant in fish can be estimated by multiplying the concentration of the chemical in surface water by the fish bioconcentration factor for the compound. This parameter is therefore an important determinant for human intakes via the aquatic food ingestion route. The Bioconcentration Factor for PCBs in fish is high (100,000 l/kg), which is supported by numerous studies.

The half-life of a compound is a measure of its persistence in the environment. This value is critical in assessing exposure potential. Table 4-4 gives the half-life of PCBs in various media. The half-life for PCBs in soil was not provided in the SPHEM manual.

Table 4-5 lists the toxicity data for PCBs. The carcinogenic potency factor for PCBs via the oral route is $4.34 \text{ (mg/kg/d)}^{-1}$ (SPHEM, 1986). At a cancer risk of 10^{-4} , the acceptable PCB dose for short-term exposure (i.e., during a one-month remediation effort) for a 70-kg person is 1.33 mg/day; for a 10^{-6} cancer risk, the short-term dose is 0.0133 mg/day (AGWSE, 1989). The acceptable dose for a lifetime exposure at a 10^{-4} risk is 1.61×10^{-3} mg/day (AGWSE, 1989). (70 kg is the average weight of an individual; SPHEM, 1986.) In humans exposed to PCBs, reported adverse effects include chloracne (a long-lasting, disfiguring skin disease), impairment of liver function, a variety of neurobehavioral and affective symptoms, menstrual disorders, minor birth abnormalities, and probably increased incidence of cancer (Clement Associates, 1985).

Toxicity increases with the length of exposure and position of the exposed species in the food chain. Three primary ways in which PCBs can affect terrestrial wildlife are outright mortality, adverse affects on reproduction, and changes in behavior (Clement Associates, 1985).

The EPA weight-of-evidence category for PCBs is Group B2, a probable human carcinogen, indicating that there is sufficient evidence of carcinogenicity in animals, but inadequate evidence of carcinogenicity in humans (SPHEM, 1986).

Source and release characterization. The source of the PCBs found at Site 3 has been defined to be the result of a "one-time event" spill from a leaking valve on Transformer P-27 in January 1983. It was reported that several gallons were released at the time of the spill.

Transport media and fate of contamination. PCBs are relatively inert, and therefore persistent compounds, with a low vapor pressure, low water solubility, and high log octanol-water partition coefficient.

Table 4-5. Toxicity Data -- Risk Characterization:**Potential Carcinogenic Effects**

Chemical Name	Oral Route			Inhalation Route		
	Potency Factor (PF) (mg/kg/day) ⁻¹	Source	EPA Weight of Evidence	Potency Factor (PF) (mg/kg/day) ⁻¹	Source	EPA Weight of Evidence
Benzo(a)pyrene	1.15E+01	HEA	B2	6.10E+00	HEA	B2
PCBs	4.34E+00	HEA	B2	NA	NA	B2
TCE	1.10E-02	HEA	B2	4.60E-03	HEA	B2

Source: SPHEM, 1986

Noncarcinogenic Effects

Chemical Name	Oral Route		Source	Inhalation Route	
	Acceptable Intake Subchron (AIS) (mg/kg/day)	Chronic (AIC) (mg/kg/day)		Acceptable Intake Subchron (AIS) (mg/kg/day)	Chronic (AIC) (mg/kg/day)
Freon 113	3.0E+01		Rfd	NA	NA

HEA = Health Effects Assessment, U.S.EPA, Cincinnati, Ohio, 1985 (updated in May, 1986)

Rfd = Agency-wide reference dose value, U.S.EPA Washington D.C., 1986

NA = Not applicable

Despite their low vapor pressure, they have a high H, which causes a higher rate of volatilization than might normally be expected. Volatilization of PCBs is believed to account for their global distribution. Once they have volatilized, the PCBs come back to earth by way of rain, snow, or dust particles, as documented by Paris and others (1978) and Gustafon (1970).

Adsorption to the organic material in soil or sediments is probably the major fate of Aroclor 1260. Once bound, the PCBs may persist for years with slow desorption providing continuous, low-level exposure to the surrounding locality.

Bioaccumulation of PCBs also occurs, with most of the compounds stored in the fatty tissues of the body. In the fatty tissues PCBs persist for years and may play a role in the increased mortality of a variety of young animals in the wild and adversely affect reproduction and behavior (USEPA, 1979). PCBs are degraded primarily by two routes. The lighter chlorinated PCBs can be biodegraded by some soil microorganisms, while the heavier PCBs (such as Aroclor 1260) are not biodegradable. These PCBs can be photolyzed by ultraviolet light; however, this process is extremely slow (Clement Associates, 1985).

Transport of PCBs from this site could occur by physical removal of contaminated soil, surface runoff, or by airborne movement of fugitive dust or vapors. Transport in soil would be slow due to the low soil permeabilities and the strong tendency for PCBs to adhere to the soil. It does occur, however, and eventually the PCBs would reach the groundwater.

Receptors, exposure points, and exposure routes. The PCB Aroclor 1260 found at Site 3 has two potential exposure routes: 1) inhalation of dust and 2) dermal exposure by direct contact with the soil. Because of the high PCB concentrations found at shallow depth, the volatilization of the PCBs and the slow degradation rates could result in inhalation of these contaminants by those working in the vicinity of the substation and those downwind of AF Plant 85. The prevailing wind direction is from the south-southwest with an average wind speed between 7 and 10 miles per hour. The city of Gahanna lies less than

2 miles to the northeast of, or downwind from, AF Plant 85, as do the four environmentally sensitive areas discussed in Section 2.5.

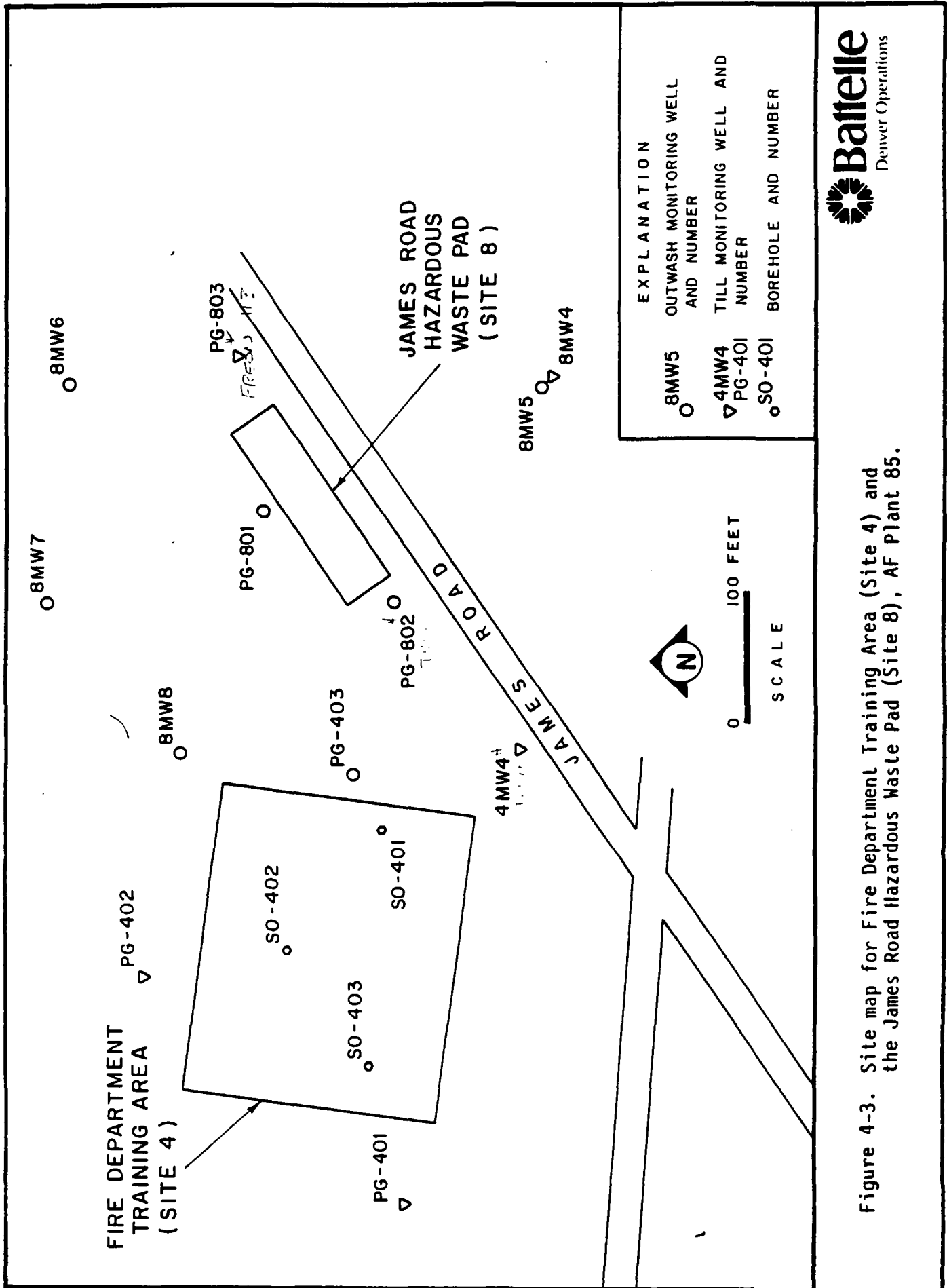
Dermal exposure by direct contact with the soil appears to be the other exposure route. This could occur when work is done at the substation, which may also release fugitive dust.

Threat to human health and wildlife and carcinogenic risks. At AF Plant 85 Site 3 the risk to both humans and wildlife is sufficiently high to warrant remedial action. PCBs are known carcinogens at small exposure dosages and concentrations of Aroclor 1260 at this site ranged from 0.06 to 700 mg/kg at depths of between 0 to 7.5 feet. Because of these high concentrations of PCBs at such a shallow depth and their ability to volatilize readily into the atmosphere, both the city of Gahanna and the environmentally sensitive areas downwind from the site are at risk. Dermal contact at the PCB Spill Site is also probable and the threat to human health and wildlife is relatively high from this exposure route; therefore, cleanup of the PCB-contaminated soil at Site 3 is necessary to reduce the threat to human health and wildlife.

4.1.2 Discussion of Results for Fire Department Training Area (Site 4) and James Road Hazardous Waste Pad (Site 8)

The proximity of these two sites has allowed them to be grouped as one for the purpose of analyzing the data. Recommendations resulting from the analyses will treat these two sites as a combined site.

The sites are in the west central part of AF Plant 85. The Fire Department Training Area (FDTA, Site 4) was used from 1941 to 1977 (Figure 4-3). At least once a month, aircraft fuels, waste oils, solvents, and waste magnesium chips were burned during fire fighting exercises. Each exercise consumed approximately 900 gallons of fuel. In 1977, the soil was excavated to a depth of about 30 inches and the area was backfilled with earth materials. The soil left in place was not sampled nor analyzed.



James Road Hazardous Waste Storage Pad (JRHP, Site 8) was used to store drums of hazardous wastes from 1941 until 1989 (Figure 4-3). These wastes included acetone, 1,1,1-trichloroethane (1,1,1-TCA), mixtures of other solvents, and phenolic paint strippers. According to the Phase I report (CH2M Hill, 1984), several spills have occurred on the ground adjacent to the concrete pad currently in place at this site; however, no visual evidence of contamination was found during the Phase I site visit. The Air Force and Rockwell International (the previous Plant operator) are presently pursuing formal closure of this RCRA-permitted storage pad.

The RI/FS, Stage 2 sampling strategy consisted of the placement and sampling of six additional groundwater monitoring wells. The Stage 1 investigation involved obtaining soil and groundwater samples and conducting a soil-gas survey performed at the Fire Department Training Area (FDTA).

4.1.2.1 Presentation of Results

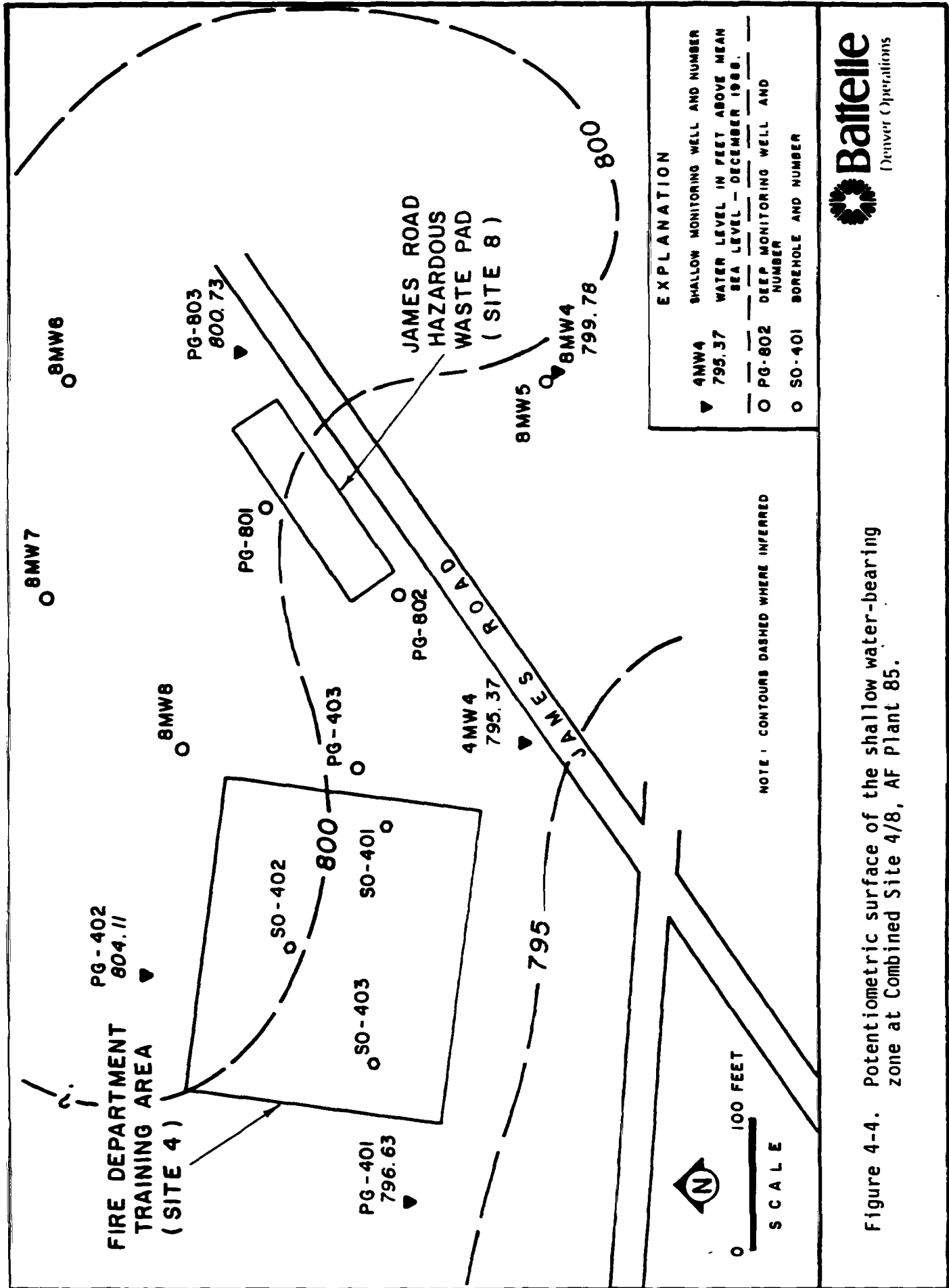
4.1.2.1.1 Site Geology. Fifteen (15) boreholes were drilled, 12 of which were converted to groundwater monitoring wells (Figure 4-3). Of the 12 monitoring wells, five monitor the till, four monitor the outwash, and three monitor transitional lithologic zones. The lithologic logs for these boreholes suggest that the till at this combined site averages 12 feet in thickness and is underlain by a thin layer of sandy clay which may act as a confining bed. The confining bed directly overlies sand and gravels of the outwash, whose total thickness is unknown. Sieve analyses were performed on soil samples collected from the till and the confining bed from monitoring wells 8MW4, 8MW6, 8MW7, and 8MW8. Samples from the till had 70% fine sand to clay-sized particles; these results imply a relative impermeability of the formation. The average moisture content was 15.5%. In the confining bed the bulk of the grains were medium sands to silt-sized with some gravel and an average moisture content of 10.4%; these results indicate that this layer is probably a semi-confining bed. Field lithologic descriptions for the outwash are of silt-, sand- and gravel-sized particles. No sieve tests were performed on any material from the outwash. Bedrock was not encountered in any of the boreholes.

4.1.2.1.2 Site Hydrology. Two water-bearing zones are present: one shallow and one deep. Two-inch diameter wells installed at the combined site screened one zone or the other. The till is monitored by wells PG401, PG402, PG802, 4MW4, and 8MW4, while PG803 monitors a transition zone between till and outwash deposits. The potentiometric surface of the shallow water-bearing zone is shown on Figures 4-4 and 2-5, which infer a groundwater mound in the vicinity of the sites. From this diagram the hydraulic gradient was determined to be 0.003. Laboratory permeability tests were performed on soil samples taken from 8MW4 and 8MW7, from depths 4 to 6 feet bgs; the results show a coefficient of permeability of 1.73×10^{-6} and 6.5×10^{-8} cm/sec, respectively. The variation is probably due to the erratic deposition of till material. These are within the range reported for glacial till in other areas (Freeze and Cherry, 1979).

The outwash is monitored by wells PG403, 8MW6, 8MW7, and 8MW8, while wells PG801 and 8MW5 monitor an interbedded zone. The potentiometric surface for the deep water-bearing zone is shown on Figures 4-5 and 2-6, which show a local aberration to the regional southwest flow. The data appear to be supportive although it is unknown why a groundwater mound is inferred in the middle of the section. The hydraulic gradient was determined to vary between 0.012 and 0.0086. Although water levels indicate the outwash is under some confined pressure at this combined site, data from nested well pairs in the shallow and deep zones indicate a downward vertical gradient (Figure 4-6).

Slug tests performed on the deep wells (primarily outwash) were analyzed using the Papadopolus and others method and the Hvorslev method (see Appendix D). The hydraulic conductivities ranged from 2×10^{-3} to 7×10^{-3} cm/sec using the Papadopolus method and ranged between 1.3×10^{-3} to 6.9×10^{-4} cm/sec using the Hvorslev method. This hydraulic conductivity indicates the material is silty to clean sand (Freeze and Cherry, 1979), which corresponds to the lithologic description. The continuity of the confining layer between the till and the outwash is not known but it probably acts as a leaky confining bed.

No surface water was found at this combined site.



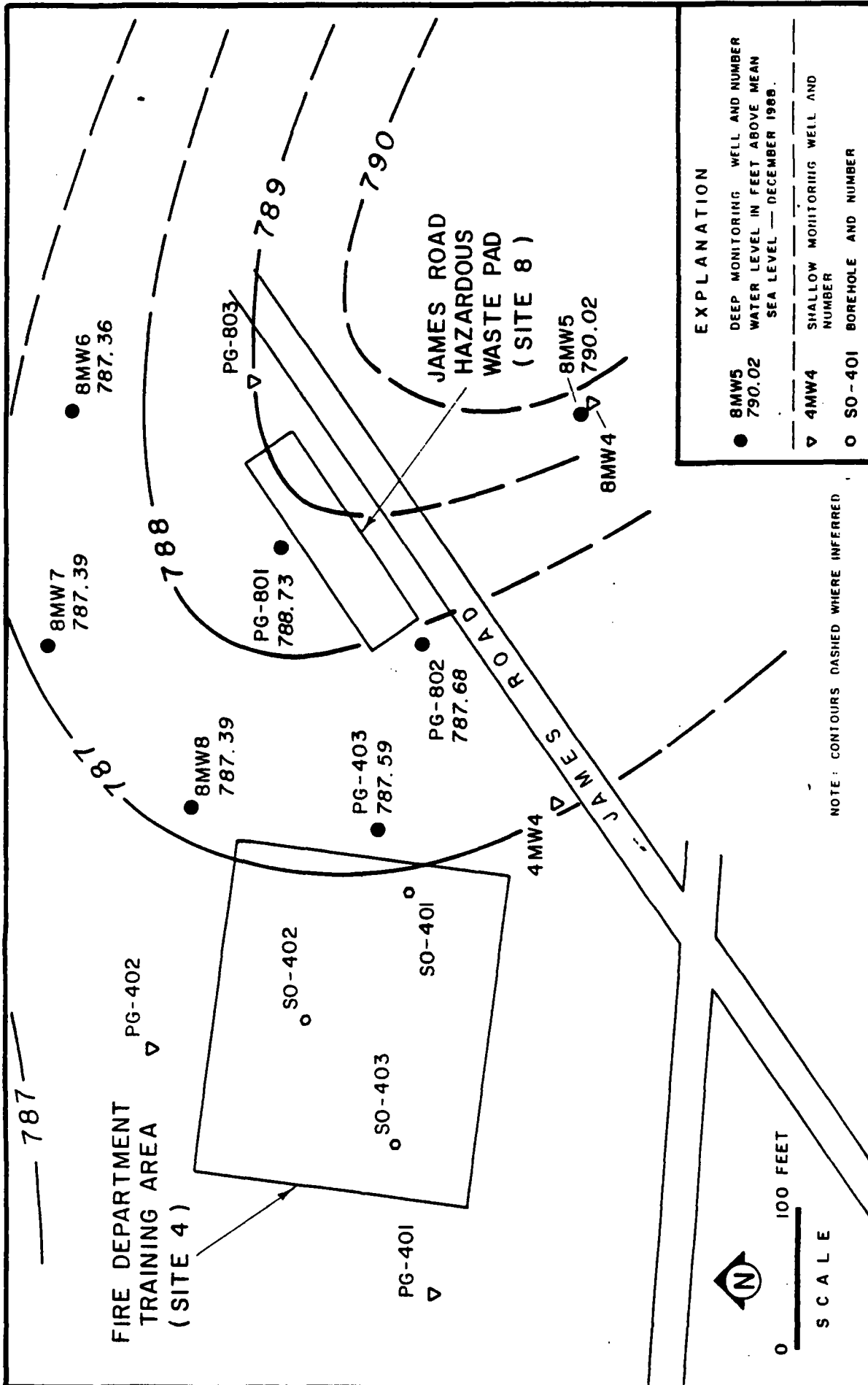


Figure 4-5. Potentiometric surface of the deep water-bearing zone at Combined Site 4/8, AF Plant 85.

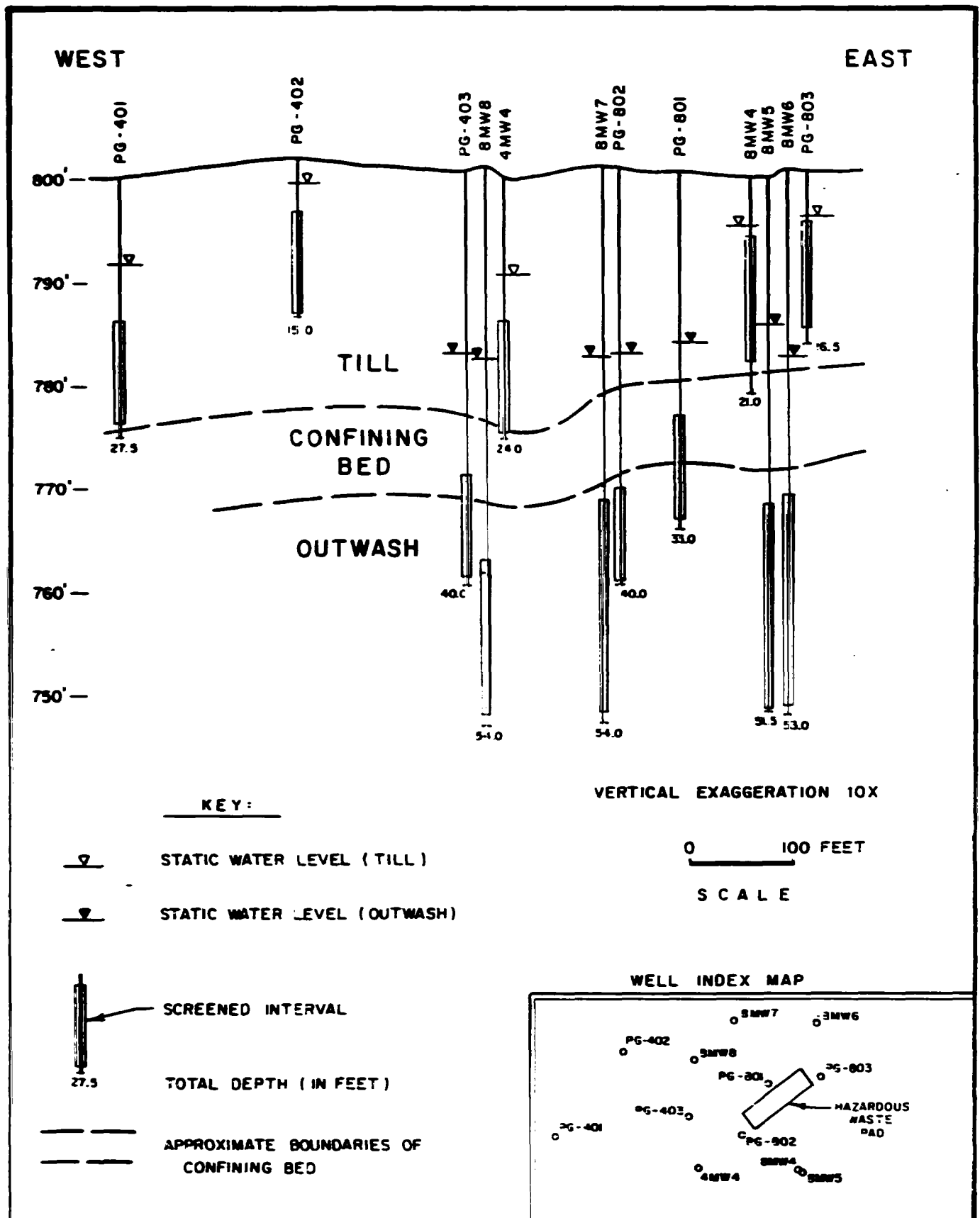


Figure 4-6. Cross-section of Combined Site 4/8.

4.1.2.1.3 Analytical Results. Eighteen (18) soil samples were collected and submitted for analysis during Stage 2; three of the samples were from the FDTA and 15 were from the JRHWP. During the Stage 1 investigation, 20 soil samples from the FDTA and nine from the JRHWP were submitted for analysis. Tables 4-6 through 4-9 shows the results from both Stage 1 and Stage 2 soil sampling. Results from the Stage 1 soil sample analyses for Site 8 are reported in wet weights rather than dry weights due to lack of percent moisture content data (which has been requested from the PEI Laboratory).

Groundwater samples were obtained from the four monitoring wells present at FDTA and the eight monitoring wells installed at JRHWP during the Stage 2 field investigation. Stage 1 groundwater sampling consisted of collecting samples from those wells installed during Stage 1; three wells were installed at each site. Tables 4-10 through 4-13 shows the chemistry results from both Stage 1 and Stage 2 groundwater sampling.

4.1.2.1.4 Discussion of Analytical Data. Several soil and groundwater samples collected from this combined site during both stages of investigation showed the presence of a variety of organic compounds.

Trichloroethylene (TCE) was detected in the three soil samples collected at borehole S0403 during Stage 1 and in one soil sample from borehole 4MW4 collected during Stage 2. Concentrations ranged from 0.042 to 189 mg/kg, with the highest value detected in borehole S0403 at a depth of between 7.5 to 9.0 feet bgs. TCE was not detected in soils sampled during the installation of monitoring wells 8MW5 through 8MW8, nor in the groundwater samples collected from monitoring wells at Sites 4 and 8. Trans-1,2-dichloroethylene (t-1,2-DCE), a breakdown products of TCE, was detected in one of the three soil samples collected at borehole S0403 (0.449 mg/kg), but was not detected in groundwater samples collected at Site 4/8.

1,1,1-Trichloroethane (1,1,1-TCA) was detected in one soil sample collected during the installation of monitoring well PG803 at a concentration of 0.0052

TABLE 4-6
ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT FOTA (SITE 4)
DURING PHASE II, STAGE 1, AF PLANT 85

Parameter	Method	Units	Method Detection Limit(s)	Standards and Action Levels		Site Station	4		4	4	4	4
				----- Federal	State		4	4				
Cadmium	SW 7130	ug/kg	0.2			401	401	401	401	401	401	401
Chromium	SW 7210	ug/kg	0.0001			401	401	401	401	401	401	401
Lead	SW 7420	ug/kg	0.000			401	401	401	401	401	401	401
Nickel	SW 7320	ug/kg	0.002			401	401	401	401	401	401	401
Oil and Grease	E 413.2	ug/kg	NA			401	401	401	401	401	401	401
1,1-Dichloroethane	SW 8010	ug/kg	0.0044			401	401	401	401	401	401	401
1,2-Dichloroethane	SW 8010	ug/kg	0.0044			401	401	401	401	401	401	401
Methylene chloride	SW 8010	ug/kg	0.0044			401	401	401	401	401	401	401
Tetrachloroethylene	SW 8010	ug/kg	0.0044			401	401	401	401	401	401	401
Trans-1,2-Dichloroethylene	SW 8010	ug/kg	0.0044			401	401	401	401	401	401	401
1,1,1-Trichloroethane	SW 8010	ug/kg	0.0044			401	401	401	401	401	401	401
Trichloroethylene	SW 8010	ug/kg	0.0040			401	401	401	401	401	401	401
Toluene	SW 8020	ug/kg	0.0034			401	401	401	401	401	401	401
Aroclor 1260	SW 8060	ug/kg	NA			401	401	401	401	401	401	401
Moisture in soil		Percent				401	401	401	401	401	401	401

(a) = Second-column confirmation required if analyte concentrations exceed 10 ug/kg.
e = Where no values are given, parameter is not regulated.
NA = Not available.
ND = Not detected.
— = Sample not analyzed for this parameter.

TABLE 4-6
ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT FOTA (SITE 4)
DURING PHASE II, STAGE 1, AF PLANT 86
(Continued)

Parameter	Method	Units	Method	Detection Limit(s)	Federal	State	Site				4			
							Station	SO 482	SO 483	SO 483	SO 483	SO 483	SO 483	SO 483
							Depth	15.0 - 18.5	5.0 - 8.5	7.5 - 9.0	7.5 - 9.0	7.5 - 9.0	7.5 - 9.0	7.5 - 9.0
							Sample Type	--	--	--	--	--	Dup 4898	--
							Date Coll.	12/24/85	12/24/85	12/24/85	12/24/85	12/24/85	12/24/85	12/24/85
							Field No.	QS-85-4898	QS-85-4897	QS-85-4898	QS-85-4898	QS-85-4898	QS-85-4898	QS-85-4899
							Lab No.	FO-210	FO-211	FO-212	FO-212	FO-212	FO-220	FO-213
Cadmium	SV 7130	mg/kg	0.2											
Chromium	SV 7210	mg/kg	0.0001											
Lead	SV 7420	mg/kg	0.000											
Nickel	SV 7320	mg/kg	0.002											
Oil and Grease	E 413.2	mg/kg	NA					156	24.5	50.1	48.7	98.3		
1,1-Dichloroethane	SV 8010	mg/kg	0.0044					ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	SV 8010	mg/kg	0.0044					ND	ND	0.0082	0.024	0.024	ND	ND
Methylene chloride	SV 8010	mg/kg	0.0044					0.055	ND	0.040	0.027	0.030	0.030	0.030
Tetrachloroethylene	SV 8010	mg/kg	0.0044					ND	ND	ND	ND	ND	ND	ND
Trans-1,2-Dichloroethylene	SV 8010	mg/kg	0.0044					ND	ND	0.449	0.299	0.299	ND	ND
1,1,1-Trichloroethane	SV 8010	mg/kg	0.0044					ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	SV 8010	mg/kg	0.0049					ND	0.233	189	1.3	0.042	0.042	0.042
Toluene	SV 8020	mg/kg	0.0034					0.023	ND	ND	ND	ND	ND	ND
Aroclor 1260	SV 8000	mg/kg	NA											
Moisture in soil		Percent						0.02	14.36	16.36	15.07	13.07		

(s) = Second-column confirmation required if analyte concentrations exceed 10 mg/kg.

e = Where no values are given, parameter is not regulated.

NA = Not available.

ND = Not detected.

-- = Sample not analyzed for this parameter.

TABLE 4-6
ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT FOTA (SITE 4)
DURING PHASE II, STAGE 1, AF PLANT 86
(Continued)

Parameter	Method	Units	Method	Detection Limit(s)	Federal	State	Site				4			
							Station	PG 401	PG 401	PG 401	PG 401	PG 401	PG 401	PG 402
Cadmium	SV 7130	ug/kg	0.2				Depth	5.0 - 0.5	7.5 - 9.0	15.0 - 10.5	15.0 - 10.5	15.0 - 10.5	15.0 - 10.5	2.5 - 4.0
Chromium	SV 7210	ug/kg	0.0001				Sample Type	--	--	--	--	Dup 4012	--	--
Lead	SV 7420	ug/kg	0.000				Date Coll.	12/30/85	12/30/85	12/30/85	12/30/85	12/30/85	12/30/85	12/30/85
Nickel	SV 7320	ug/kg	0.002				Field No.	CS-85-4010	CS-85-4011	CS-85-4012	CS-85-4017	CS-85-4013	CS-85-4013	CS-85-4013
							Lab No.	FQ-214	FQ-215	FQ-216	FQ-221	FQ-217	FQ-217	FQ-217
Oil and Grease	E 413.2	ug/kg	NA					36.7	37.4	210	200	20.3	20.3	20.3
1,1-Dichloroethane	SV 8010	ug/kg	0.0044					ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	SV 8010	ug/kg	0.0044					0.0006	1.138	ND	ND	ND	ND	ND
Methylene chloride	SV 8010	ug/kg	0.0044					0.032	0.102	0.020	0.020	0.020	0.020	0.020
Tetrachloroethylene	SV 8010	ug/kg	0.0044					ND	ND	ND	ND	ND	ND	ND
Trans-1,2-Dichloroethylene	SV 8010	ug/kg	0.0044					ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	SV 8010	ug/kg	0.0044					ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	SV 8010	ug/kg	0.0040					ND	ND	ND	ND	ND	ND	ND
Toluene	SV 8020	ug/kg	0.0034					0.007	ND	0.072	ND	ND	ND	ND
Aroclor 1200	SV 8000	ug/kg	NA					--	--	--	--	--	--	--
Moisture in soil		Percent						17.40	18.54	14.09	14.50	10.37	10.37	10.37

(s) = Second-column confirmation required if analyte concentrations exceed 10 ug/kg.
0 = Where no values are given, parameter is not regulated.

NA = Not available.

ND = Not detected.

-- = Sample not analyzed for this parameter.

TABLE 4-8
ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT FDYA (SITE 4)
DURING PHASE II, STAGE 1, AF PLANT 86
(Continued)

Parameter	Method	Units	Method	Detection Limit(a)	Federal	State	Site				4			
							Station	PQ 492	PQ 492	PQ 492	PQ 493	PQ 493	PQ 493	PQ 493
							Depth	7.5 - 9.0	10.0 - 11.5	12.5 - 4.0	2.5 - 4.0	5.0 - 8.5	10.0 - 11.5	10.0 - 11.5
							Sample Type	--	--	--	--	--	--	--
							Date Coll.	12/30/86	12/30/86	12/30/86	12/30/86	12/30/86	12/30/86	12/30/86
							Field No.	GS-86-4914	GS-86-4915	GS-86-4918	GS-86-4919	GS-86-4920	GS-86-4920	GS-86-4920
							Lab No.	FQ-218	FQ-219	FE-585	FQ-586	FQ-587	FQ-587	FQ-587
Cadmium	SW 7130	ug/kg	0.2											
Chromium	SW 7210	ug/kg	0.0001											
Lead	SW 7420	ug/kg	0.008											
Nickel	SW 7320	ug/kg	0.002											
Oil and Grease	E 413.2	ug/kg	NA											
1,1-Dichloroethane	SW 8010	ug/kg	0.0044											
1,2-Dichloroethane	SW 8010	ug/kg	0.0044											
Methylene chloride	SW 8010	ug/kg	0.0044											
Tetrachloroethylene	SW 8010	ug/kg	0.0044											
Trans-1,2-Dichloroethylene	SW 8010	ug/kg	0.0044											
1,1,1-Trichloroethane	SW 8010	ug/kg	0.0044											
Trichloroethylene	SW 8010	ug/kg	0.0049											
Toluene	SW 8020	ug/kg	0.0034											
Aroclor 1260	SW 8000	ug/kg	NA											
Moisture in soil		Percent												

(a) = Second-column confirmation required if analyte concentrations exceed 10 ug/kg.

0 = Where no values are given, parameter is not regulated.

NA = Not available.

ND = Not detected.

-- = Sample not analyzed for this parameter.

TABLE 4-7. ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT FOTA (SITE 4)
DURING RI/FS, STAGE 2, AF PLANT 06

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels ----- Federal State	Site Station Depth	4 MW4 6.0-7.5	4 MW4 9.0-10.5	4 MW4 19.0-20.0
					Sample Type Date Coll. Field No. Lab No.	10/12/00 005-S0-004-001 0010235+1	10/12/00 005-S0-004-002 0010235+2	10/12/00 005-S0-004-003 0010235+3
Silver	SW 0010	ng/kg	0.5			---	---	---
Aluminum	SW 0010	ng/kg	5			---	---	---
Barium	SW 0010	ng/kg	0.1			---	---	---
Beryllium	SW 0010	ng/kg	0.00			---	---	---
Calcium	SW 0010	ng/kg	0.3			---	---	---
Cadmium	SW 0010	ng/kg	0.5			---	---	---
Cobalt	SW 0010	ng/kg	1			---	---	---
Chromium	SW 0010	ng/kg	1			---	---	---
Copper	SW 0010	ng/kg	0.5			---	---	---
Iron	SW 0010	ng/kg	0.5			---	---	---
Potassium	SW 0010	ng/kg	20			---	---	---
Magnesium	SW 0010	ng/kg	0.3			---	---	---
Manganese	SW 0010	ng/kg	0.1			---	---	---
Sodium	SW 0010	ng/kg	3			---	---	---
Nickel	SW 0010	ng/kg	1			---	---	---
Vanadium	SW 0010	ng/kg	0.0			---	---	---
Zinc	SW 0010	ng/kg	0.0			---	---	---
Mercury	SW 7471	ng/kg	0.4			---	---	---
Acenaphthene	SW 0270	ng/kg	0.5			ND	ND	ND
Anthracene	SW 0270	ng/kg	0.5			ND	ND	ND
Benzo(a)anthracene	SW 0270	ng/kg	0.5			ND	ND	ND
Benzo(a)pyrene	SW 0270	ng/kg	0.5			ND	ND	ND
Benzo(b)fluoranthene	SW 0270	ng/kg	0.5			ND	ND	ND
Benzo(g,h,i)perylene	SW 0270	ng/kg	0.5			ND	ND	ND
Benzo(k)fluoranthene	SW 0270	ng/kg	0.5			ND	ND	ND
Chrysene	SW 0270	ng/kg	0.5			ND	ND	ND
Dibenz(a,h)anthracene	SW 0270	ng/kg	0.5			ND	ND	ND
Dibenzofuran	SW 0270	ng/kg	0.5			ND	ND	ND
Fluoranthene	SW 0270	ng/kg	0.5			ND	ND	ND
Fluorene	SW 0270	ng/kg	0.5			ND	ND	ND
Indeno(1,2,3-c,d)pyrene	SW 0270	ng/kg	0.5			ND	ND	ND
2-Methylnaphthalene	SW 0270	ng/kg	0.5			ND	ND	ND
Naphthalene	SW 0270	ng/kg	0.5			ND	ND	ND
N-Nitrosodiphenylamine	SW 0270	ng/kg	0.5			ND	ND	ND
Phenanthrene	SW 0270	ng/kg	0.5			ND	ND	ND
Pyrene	SW 0270	ng/kg	0.5			ND	ND	ND
Semi-Quantified SW 0270 Compounds								
C10H8O2 Compound	SW 0270	ng/kg	1			ND	ND	ND
C15H10 Hydrocarbon	SW 0270	ng/kg	1			ND	ND	ND
Area. C8H12 Hydrocarbon(1)	SW 0270	ng/kg	10			ND	ND	ND
Area. C8H12 Hydrocarbon(2)	SW 0270	ng/kg	10			ND	ND	ND
Area. C10H12 Hydrocarbon	SW 0270	ng/kg	10			ND	ND	ND
Area. C17H12 Hydrocarbon	SW 0270	ng/kg	10			ND	ND	ND
Area. C18H12 Hydrocarbon	SW 0270	ng/kg	10			ND	ND	ND
Benzo(a)pyrene Isomer	SW 0270	ng/kg	10			ND	ND	ND
Substituted Phenanthrene	SW 0270	ng/kg	10			ND	ND	ND
Oxygenated C14 Compound	SW 0270	ng/kg	10			ND	ND	ND
Carbazole (C12H8N2)	SW 0270	ng/kg	10			ND	ND	ND
Dibenzothiophene (C12H8S)	SW 0270	ng/kg	10			ND	ND	ND
Nitrogenated Compound	SW 0270	ng/kg	1			ND	ND	ND
C10-C20 Hydrocarbon Matrix	SW 0270	ng/kg	1			ND	ND	ND
C25-C35 Hydrocarbon Matrix	SW 0270	ng/kg	1			ND	200	100
Methylene chloride	SW 0240	ng/kg	0.0			ND	ND	ND
Trichloroethylene	SW 0240	ng/kg	0.4			ND	ND	0.5
Moisture in soil		Percent				11	9	14

- = Where no values are given, parameter is not regulated.

ND = Quantification based upon comparison of total ion count of the compound with that of the nearest internal standard.

ND = Not detected.

- = Sample not analyzed for this parameter.

TABLE 4-8
ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT JRMWP (SITE 8)
DURING PHASE II, STAGE 1, AF PLANT 85

Parameter	Method	Units	Detection Limit(a)	Method	Standards and Action Levels	Site			
						Station	PQ 881	PQ 881	PQ 882
					Depth	5.0 - 0.5	12.5 - 14.0	30.0 - 31.5	2.5 - 4.0
					Sample Type	---	---	---	---
					Date Coll.	12/31/85	12/31/85	12/31/85	01/02/86
					Field No.	QS-85-0001	QS-85-0003	QS-85-0002	QS-85-0001
					Lab No.	FE-500	FE-500	FE-500	FE-501
Cadmium	SW 7130	mg/kg	0.2						
Chromium	SW 7210	mg/kg	0.0001						
Lead	SW 7420	mg/kg	0.000						
Nickel	SW 7320	mg/kg	0.002						
Oil and Grease	E 413.2	mg/kg	NA						
1,1-Dichloroethane	SW 8010	mg/kg	0.0044						
1,2-Dichloroethane	SW 8010	mg/kg	0.0044						
Methylene chloride	SW 8010	mg/kg	0.0044						
Tetrachloroethylene	SW 8010	mg/kg	0.0044						
Trans-1,2-Dichloroethylene	SW 8010	mg/kg	0.0044						
1,1,1-Trichloroethane	SW 8010	mg/kg	0.0044						
Trichloroethylene	SW 8010	mg/kg	0.0049						
Toluene	SW 8020	mg/kg	0.0034						
Aroclor 1260	SW 8000	mg/kg	NA						
Moisture in soil **		Percent							

(a) = Second-column confirmation required if analyte concentrations exceed 10 mg/kg.

* = Where no values are given, parameter is not regulated.

NA = Not available.

ND = Not detected.

— = Sample not analyzed for this parameter.

** = Percent moisture currently not available, results are presented on a wet weight basis.

TABLE 4-6
ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT JMWPP ((SITE 8))
DURING PHASE II, STAGE 1, AF PLANT 88
(Continued)

Parameter	Method	Units	Method Detection Limit(s)	Standards and Action Levels ----- Federal State	Site					
					Station	PQ 002	PQ 002	PQ 002	PQ 002	PQ 003
					Depth	7.5 - 9.0	7.5 - 9.0	20.0 - 21.5	---	5.0 - 6.6
					Sample Type	---	Dup 0002	---	---	---
					Date Coll.	01/02/00	01/02/00	01/02/00	01/02/00	01/03/00
					Field No.	03-00-0002	03-00-0007	03-00-0003	03-00-0004	03-00-0004
					Lab No.	FE-502	FE-507	FE-503	FE-504	FE-504
Cadmium	SW 7130	ug/kg	0.2							
Chromium	SW 7210	ug/kg	0.0001							
Lead	SW 7430	ug/kg	0.000							
Nickel	SW 7320	ug/kg	0.002							
Oil and Grease	E 413.2	ug/kg	NA			32.3	30.0	1.45	55.2	
1,1-Dichloroethane	SW 0010	ug/kg	0.0044			ND		ND	ND	ND
1,2-Dichloroethane	SW 0010	ug/kg	0.0044			ND		ND	ND	ND
Methylene chloride	SW 0010	ug/kg	0.0044			ND		ND	ND	ND
Tetrachloroethylene	SW 0010	ug/kg	0.0044			ND		ND	ND	ND
Trans-1,2-Dichloroethylene	SW 0010	ug/kg	0.0044			ND		ND	ND	ND
1,1,1-Trichloroethane	SW 0010	ug/kg	0.0044			ND		ND	ND	ND
Trichloroethylene	SW 0010	ug/kg	0.0040			ND		ND	ND	ND
Toluene	SW 0020	ug/kg	0.0034			0.040		0.100	0.000	
Aroclor 1260	SW 0000	ug/kg	NA							
Moisture in soil %		Percent								

(a) = Second-column confirmation required if analyte concentrations exceed 10 ug/kg.

0 = Where no values are given, parameter is not regulated.

NA = Not available.

ND = Not detected.

— = Sample not analyzed for this parameter.

% = Percent moisture currently not available, results are presented on a wet weight basis.

TABLE 4-8
ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT JRHP ((SITE 8))
DURING PHASE II, STAGE 1, AF PLANT 85
(Continued)

Parameter	Method	Units	Method	Detection Limit(s)	Federal	State	Site			
							Station	PQ 883	PQ 883	PQ 883
							Depth	7.5 - 9.0	7.5 - 9.0	12.5 - 14.0
							Sample Type	---	Dup 8886	---
							Date Coll.	01/03/86	01/03/86	01/03/86
							Field No.	QS-88-8886	QS-88-8888	QS-88-8886
							Lab No.	FE-595	FE-598	FE-598
Cadmium	SW 7136	ng/kg	0.2							
Chromium	SW 7216	ng/kg	0.0001							
Lead	SW 7426	ng/kg	0.008							
Nickel	SW 7326	ng/kg	0.002							
Oil and Grease	E 413.2	ng/kg	NA				98.1	66.4	86.6	
1,1-Dichloroethane	SW 8810	ng/kg	0.0044				ND	ND	ND	
1,2-Dichloroethane	SW 8810	ng/kg	0.0044				1.986	0.758	ND	
Methylene chloride	SW 8810	ng/kg	0.0044				0.635	ND	0.061	
Tetrachloroethylene	SW 8810	ng/kg	0.0044				ND	ND	ND	
Trans-1,2-Dichloroethylene	SW 8810	ng/kg	0.0044				ND	ND	ND	
1,1,1-Trichloroethane	SW 8810	ng/kg	0.0044				0.0052	0.022	ND	
Trichloroethylene	SW 8810	ng/kg	0.0049				ND	ND	ND	
Toluene	SW 8820	ng/kg	0.0034				0.068	0.130	0.094	
Aroclor 1260	SW 8800	ng/kg	NA							
Moisture in soil **		Percent								

(a) = Second-column confirmation required if analyte concentrations exceed 10 ng/kg.

* = Where no values are given, parameter is not regulated.

NA = Not available.

ND = Not detected.

— = Sample not analyzed for this parameter.

** = Percent moisture currently not available, results are presented on a wet weight basis.

TABLE 4-9. ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT JMWHP (SITE 8)
DURING RI/FS, STAGE 2, AF PLANT 06

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels		Site	8	8	8
				Federal	State	Station	MB4	MB4	MB4
						Depth	6.0-7.5	9.0-10.5	14.0-15.5
						Sample Type	--	--	--
Date Coll.	12/13/88	10/13/88	10/13/88						
Field No.	005-S0-000-001	005-S0-000-002	005-S0-000-003						
Lab No.	0010235+4	0010235+5	0010235+6						
Silver	SW 0010	ng/kg	0.5						
Aluminum	SW 0010	ng/kg	5						
Barium	SW 0010	ng/kg	0.1						
Beryllium	SW 0010	ng/kg	0.00						
Calcium	SW 0010	ng/kg	0.3						
Cadmium	SW 0010	ng/kg	0.5						
Cobalt	SW 0010	ng/kg	1						
Chromium	SW 0010	ng/kg	1						
Copper	SW 0010	ng/kg	0.5						
Iron	SW 0010	ng/kg	0.5						
Potassium	SW 0010	ng/kg	20						
Magnesium	SW 0010	ng/kg	0.3						
Manganese	SW 0010	ng/kg	0.1						
Sodium	SW 0010	ng/kg	3						
Nickel	SW 0010	ng/kg	1						
Vanadium	SW 0010	ng/kg	0.0						
Zinc	SW 0010	ng/kg	0.0						
Mercury	SW 7471	ng/kg	0.4						
Acenaphthene	SW 0270	ng/kg	0.5			ND	ND	ND	
Anthracene	SW 0270	ng/kg	0.5			ND	ND	ND	
Benzo(a)anthracene	SW 0270	ng/kg	0.5			ND	ND	ND	
Benzo(a)pyrene	SW 0270	ng/kg	0.5			ND	ND	ND	
Benzo(b)fluoranthene	SW 0270	ng/kg	0.5			ND	ND	ND	
Benzo(g,h,i)perylene	SW 0270	ng/kg	0.5			ND	ND	ND	
Benzo(k)fluoranthene	SW 0270	ng/kg	0.5			ND	ND	ND	
Chrysene	SW 0270	ng/kg	0.5			ND	ND	ND	
Dibenzo(a,h)anthracene	SW 0270	ng/kg	0.5			ND	ND	ND	
Dibenzofuran	SW 0270	ng/kg	0.5			ND	ND	ND	
Fluoranthene	SW 0270	ng/kg	0.5			ND	ND	ND	
Fluorene	SW 0270	ng/kg	0.5			ND	ND	ND	
Indeno(1,2,3-c,d)pyrene	SW 0270	ng/kg	0.5			ND	ND	ND	
2-Methylnaphthalene	SW 0270	ng/kg	0.5			ND	ND	ND	
Naphthalene	SW 0270	ng/kg	0.5			ND	ND	ND	
N-Nitrosodiphenylamine	SW 0270	ng/kg	0.5			ND	ND	ND	
Phenanthrene	SW 0270	ng/kg	0.5			ND	ND	ND	
Pyrene	SW 0270	ng/kg	0.5			ND	ND	ND	
Semi-Quantified SW 0270 Compounds									
C14H10 Compound	SW 0270	ng/kg	1			ND	ND	ND	
C15H10 Hydrocarbon	SW 0270	ng/kg	1			ND	ND	ND	
Area. C16H12 Hydrocarbon(1)	SW 0270	ng/kg	10			ND	ND	ND	
Area. C16H12 Hydrocarbon(2)	SW 0270	ng/kg	10			ND	ND	ND	
Area. C16 Hydrocarbon	SW 0270	ng/kg	10			ND	ND	ND	
Area. C17H12 Hydrocarbon	SW 0270	ng/kg	10			ND	ND	ND	
Area. C18H12 Hydrocarbon	SW 0270	ng/kg	10			ND	ND	ND	
Benzo(a)pyrene Isomer	SW 0270	ng/kg	10			ND	ND	ND	
Substituted Phenanthrene	SW 0270	ng/kg	10			ND	ND	ND	
Oxygenated C14 Compound	SW 0270	ng/kg	10			ND	ND	ND	
Carbazole (C12H9N)	SW 0270	ng/kg	10			ND	ND	ND	
Dibenzothiophene (C12H8S)	SW 0270	ng/kg	10			ND	ND	ND	
Nitrogenated Compound	SW 0270	ng/kg	1			ND	ND	ND	
C10-C20 Hydrocarbon Matrix	SW 0270	ng/kg	1			ND	ND	ND	
C25-C35 Hydrocarbon Matrix	SW 0270	ng/kg	1			ND	06	ND	
Methylene chloride	SW 0240	ng/kg	0.0			ND	ND	ND	
Trichloroethylene	SW 0240	ng/kg	0.4			ND	ND	ND	
Moisture in soil		Percent				12	11	8	

• = Where no values are given, parameter is not regulated.

•• = Quantification based upon comparison of total ion count of the compound with that of the nearest internal standard.

ND = Not detected.

— = Sample not analyzed for this parameter.

TABLE 4-9. ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT JRHWP (SITE 8)
DURING RI/FS, STAGE 2, AF PLANT 85
(Continued)

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels		Site Station Depth	8 MW5 14.6-15.5	8 MW5 29.8-30.5	8 MW5 29.8-30.5
				Federal	State	Sample Type Date Coll. Field No. Lab No.	10/14/88 085-SO-008-004 8810247+1	10/17/88 085-SO-008-008 8810298+1	10/17/88 Dup 008-008 085-SO-008-009 8810298+2
Silver	SW 8010	ag/kg	0.5				---	---	---
Aluminum	SW 8010	ag/kg	5				---	---	---
Barium	SW 8010	ag/kg	0.1				---	---	---
Beryllium	SW 8010	ag/kg	0.03				---	---	---
Calcium	SW 8010	ag/kg	0.3				---	---	---
Cadmium	SW 8010	ag/kg	0.5				---	---	---
Cobalt	SW 8010	ag/kg	1				---	---	---
Chromium	SW 8010	ag/kg	1				---	---	---
Copper	SW 8010	ag/kg	0.5				---	---	---
Iron	SW 8010	ag/kg	0.5				---	---	---
Potassium	SW 8010	ag/kg	20				---	---	---
Magnesium	SW 8010	ag/kg	0.3				---	---	---
Manganese	SW 8010	ag/kg	0.1				---	---	---
Sodium	SW 8010	ag/kg	3				---	---	---
Nickel	SW 8010	ag/kg	1				---	---	---
Vanadium	SW 8010	ag/kg	0.8				---	---	---
Zinc	SW 8010	ag/kg	0.8				---	---	---
Mercury	SW 7471	ag/kg	0.4				---	---	---
Acenaphthene	SW 8270	ag/kg	0.5				ND	ND	ND
Anthracene	SW 8270	ag/kg	0.5				ND	ND	ND
Benzo(a)anthracene	SW 8270	ag/kg	0.5				ND	ND	ND
Benzo(a)pyrene	SW 8270	ag/kg	0.5				ND	ND	ND
Benzo(b)fluoranthene	SW 8270	ag/kg	0.5				ND	ND	ND
Benzo(g,h,i)perylene	SW 8270	ag/kg	0.5				ND	ND	ND
Benzo(k)fluoranthene	SW 8270	ag/kg	0.5				ND	ND	ND
Chrysene	SW 8270	ag/kg	0.5				ND	ND	ND
Dibenzo(a,h)anthracene	SW 8270	ag/kg	0.5				ND	ND	ND
Dibenzofuran	SW 8270	ag/kg	0.5				ND	ND	ND
Fluoranthene	SW 8270	ag/kg	0.5				ND	ND	ND
Fluorene	SW 8270	ag/kg	0.5				ND	ND	ND
Indeno(1,2,3-c,d)pyrene	SW 8270	ag/kg	0.5				ND	ND	ND
2-Methylnaphthalene	SW 8270	ag/kg	0.5				ND	ND	ND
Naphthalene	SW 8270	ag/kg	0.5				ND	ND	ND
N-Nitrosodiphenylamine	SW 8270	ag/kg	0.5				ND	ND	ND
Phenanthrene	SW 8270	ag/kg	0.5				ND	ND	ND
Pyrene	SW 8270	ag/kg	0.5				ND	ND	ND
Semi-Quantified SW 8270 Compounds**									
C14H8O2 Compound	SW 8270	ag/kg	1				ND	ND	ND
C15H10 Hydrocarbon	SW 8270	ag/kg	1				ND	ND	ND
Arom. C5H12 Hydrocarbon(1)	SW 8270	ag/kg	10				ND	ND	ND
Arom. C5H12 Hydrocarbon(2)	SW 8270	ag/kg	10				ND	ND	ND
Arom. C16 Hydrocarbon	SW 8270	ag/kg	10				ND	ND	ND
Arom. C17H12 Hydrocarbon	SW 8270	ag/kg	10				ND	ND	ND
Arom. C18H12 Hydrocarbon	SW 8270	ag/kg	10				ND	ND	ND
Benzopyrene Isomer	SW 8270	ag/kg	10				ND	ND	ND
Substituted Phenanthrene	SW 8270	ag/kg	10				ND	ND	ND
Oxygenated C14 Compound	SW 8270	ag/kg	10				ND	ND	ND
Carbazole (C12H9N)	SW 8270	ag/kg	10				ND	ND	ND
Dibenzothiophene (C12H8S)	SW 8270	ag/kg	10				ND	ND	ND
Nitrogenated Compound	SW 8270	ag/kg	1				ND	ND	ND
C10-C20 Hydrocarbon Matrix	SW 8270	ag/kg	1				ND	ND	ND
C25-C35 Hydrocarbon Matrix	SW 8270	ag/kg	1				ND	ND	ND
Methylene chloride	SW 8240	ag/kg	0.6				ND	ND	ND
Trichloroethylene	SW 8240	ag/kg	0.4				ND	ND	ND
Moisture in soil		Percent					7	8	8

* = Where no values are given, parameter is not regulated.

** = Quantification based upon comparison of total ion count of the compound with that of the nearest internal standard.

ND = Not detected.

— = Sample not analyzed for this parameter.

TABLE 4-9. ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT JRNHP (SITE 8)
DURING RI/FS, STAGE 2, AF PLANT 06
(Continued)

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels		Site Station	8	8	8
				Federal	State	Depth	44.8-45.8	9.8-10.5	9.8-10.5
						Sample Type	---	---	Dup 008-005
						Date Coll.	10/17/00	10/14/00	10/14/00
						Field No.	005-S0-000-010	005-S0-000-005	005-S0-000-006
						Lab No.	0010290+3	0010247+2	0010247+3
Silver	SR 0010	ng/kg	0.5				---	---	---
Aluminum	SR 0010	ng/kg	5				---	---	---
Barium	SR 0010	ng/kg	0.1				---	---	---
Beryllium	SR 0010	ng/kg	0.00				---	---	---
Calcium	SR 0010	ng/kg	0.3				---	---	---
Cadmium	SR 0010	ng/kg	0.5				---	---	---
Cobalt	SR 0010	ng/kg	1				---	---	---
Chromium	SR 0010	ng/kg	1				---	---	---
Copper	SR 0010	ng/kg	0.5				---	---	---
Iron	SR 0010	ng/kg	0.5				---	---	---
Potassium	SR 0010	ng/kg	20				---	---	---
Magnesium	SR 0010	ng/kg	0.3				---	---	---
Manganese	SR 0010	ng/kg	0.1				---	---	---
Sodium	SR 0010	ng/kg	3				---	---	---
Nickel	SR 0010	ng/kg	1				---	---	---
Vanadium	SR 0010	ng/kg	0.0				---	---	---
Zinc	SR 0010	ng/kg	0.0				---	---	---
Mercury	SR 7471	ng/kg	0.4				---	---	---
Acenaphthene	SR 0270	ng/kg	0.5				ND	ND	ND
Anthracene	SR 0270	ng/kg	0.5				ND	ND	ND
Benzo(a)anthracene	SR 0270	ng/kg	0.5				ND	ND	ND
Benzo(a)pyrene	SR 0270	ng/kg	0.5				ND	ND	ND
Benzo(b)fluoranthene	SR 0270	ng/kg	0.5				ND	ND	ND
Benzo(g,h,i)perylene	SR 0270	ng/kg	0.5				ND	ND	ND
Benzo(k)fluoranthene	SR 0270	ng/kg	0.5				ND	ND	ND
Chrysene	SR 0270	ng/kg	0.5				ND	ND	ND
Dibenzo(a,h)anthracene	SR 0270	ng/kg	0.5				ND	ND	ND
Dibenzofuran	SR 0270	ng/kg	0.5				ND	ND	ND
Fluoranthene	SR 0270	ng/kg	0.5				ND	ND	ND
Fluorene	SR 0270	ng/kg	0.5				ND	ND	ND
Indeno(1,2,3-c,d)pyrene	SR 0270	ng/kg	0.5				ND	ND	ND
2-Methylnaphthalene	SR 0270	ng/kg	0.5				ND	ND	ND
Naphthalene	SR 0270	ng/kg	0.5				ND	ND	ND
N-Mitroodiphenylamine	SR 0270	ng/kg	0.5				ND	ND	ND
Phenanthrene	SR 0270	ng/kg	0.5				ND	ND	ND
Pyrene	SR 0270	ng/kg	0.5				ND	ND	ND
Semi-Quantified SR 0270 Compounds									
C14H10O2 Compound	SR 0270	ng/kg	1				ND	ND	ND
C15H12 Hydrocarbon	SR 0270	ng/kg	1				ND	ND	ND
Area. C16H12 Hydrocarbon (1)	SR 0270	ng/kg	10				ND	ND	ND
Area. C16H12 Hydrocarbon (2)	SR 0270	ng/kg	10				ND	ND	ND
Area. C18 Hydrocarbon	SR 0270	ng/kg	10				ND	ND	ND
Area. C17H12 Hydrocarbon	SR 0270	ng/kg	10				ND	ND	ND
Area. C18H12 Hydrocarbon	SR 0270	ng/kg	10				ND	ND	ND
Benzo(a)pyrene Isomer	SR 0270	ng/kg	10				ND	ND	ND
Substituted Phenanthrene	SR 0270	ng/kg	10				ND	ND	ND
Brominated C14 Compound	SR 0270	ng/kg	10				ND	ND	ND
Carbazole (C12H8N2)	SR 0270	ng/kg	10				ND	ND	ND
Dibenzothiophene (C12H6S)	SR 0270	ng/kg	10				ND	ND	ND
Nitrogenated Compound	SR 0270	ng/kg	1				ND	ND	ND
C10-C20 Hydrocarbon Matrix	SR 0270	ng/kg	1				ND	ND	ND
C25-C36 Hydrocarbon Matrix	SR 0270	ng/kg	1				ND	ND	ND
Methylene chloride	SR 0240	ng/kg	0.0				ND	ND	ND
Trichloroethylene	SR 0240	ng/kg	0.4				ND	ND	ND
Moisture in soil		Percent					9	10	17

o = Where no values are given, parameter is not regulated.

oo = Quantification based upon comparison of total ion count of the compound with that of the nearest internal standard.

ND = Not detected.

— = Sample not analyzed for this parameter.

TABLE 4-9. ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT JRHWP (SITE 8)
DURING RI/FS, STAGE 2, AF PLANT 85
(Continued)

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels*		Site Station Depth	8 MW6 14.8-15.5	8 MW6 29.8-30.5	8 MW7 6.6-7.5
				Federal	State	Sample Type Date Coll. Field No. Lab No.	10/14/88 885-SO-008-007 8818247+4	10/18/88 885-SO-008-011 8818298+4	10/19/88 885-SO-008-012 8818345+1
Silver	SW 8818	ug/kg	0.5				---	---	---
Aluminum	SW 8818	ug/kg	5				---	---	---
Barium	SW 8818	ug/kg	0.1				---	---	---
Beryllium	SW 8818	ug/kg	0.03				---	---	---
Calcium	SW 8818	ug/kg	0.3				---	---	---
Cadmium	SW 8818	ug/kg	0.5				---	---	---
Cobalt	SW 8818	ug/kg	1				---	---	---
Chromium	SW 8818	ug/kg	1				---	---	---
Copper	SW 8818	ug/kg	0.5				---	---	---
Iron	SW 8818	ug/kg	0.5				---	---	---
Potassium	SW 8818	ug/kg	20				---	---	---
Magnesium	SW 8818	ug/kg	0.3				---	---	---
Manganese	SW 8818	ug/kg	0.1				---	---	---
Sodium	SW 8818	ug/kg	3				---	---	---
Nickel	SW 8818	ug/kg	1				---	---	---
Vanadium	SW 8818	ug/kg	0.8				---	---	---
Zinc	SW 8818	ug/kg	0.8				---	---	---
Mercury	SW 7471	ug/kg	0.4				---	---	---
Acenaphthene	SW 8270	ug/kg	0.5				ND	ND	ND
Anthracene	SW 8270	ug/kg	0.5				ND	ND	ND
Benzo(a)anthracene	SW 8270	ug/kg	0.5				ND	ND	ND
Benzo(a)pyrene	SW 8270	ug/kg	0.5				ND	ND	ND
Benzo(b)fluoranthene	SW 8270	ug/kg	0.5				ND	ND	ND
Benzo(g,h,i)perylene	SW 8270	ug/kg	0.5				ND	ND	ND
Benzo(k)fluoranthene	SW 8270	ug/kg	0.5				ND	ND	ND
Chrysene	SW 8270	ug/kg	0.5				ND	ND	ND
Dibenzo(a,h)anthracene	SW 8270	ug/kg	0.5				ND	ND	ND
Dibenzofuran	SW 8270	ug/kg	0.5				ND	ND	ND
Fluoranthene	SW 8270	ug/kg	0.5				ND	ND	ND
Fluorene	SW 8270	ug/kg	0.5				ND	ND	ND
Indeno(1,2,3-c,d)pyrene	SW 8270	ug/kg	0.5				ND	ND	ND
2-Methylnaphthalene	SW 8270	ug/kg	0.5				ND	ND	ND
Naphthalene	SW 8270	ug/kg	0.5				ND	ND	ND
N-Nitrosodiphenylamine	SW 8270	ug/kg	0.5				ND	ND	ND
Phenanthrene	SW 8270	ug/kg	0.5				ND	ND	ND
Pyrene	SW 8270	ug/kg	0.5				ND	ND	ND
Semi-Quantified SW 8270 Compounds**									
C14H8O2 Compound	SW 8270	ug/kg	1				ND	ND	ND
C15H10 Hydrocarbon	SW 8270	ug/kg	1				ND	ND	ND
Arom. C5H12 Hydrocarbon(1)	SW 8270	ug/kg	10				ND	ND	ND
Arom. C5H12 Hydrocarbon(2)	SW 8270	ug/kg	10				ND	ND	ND
Arom. C16 Hydrocarbon	SW 8270	ug/kg	10				ND	ND	ND
Arom. C17H12 Hydrocarbon	SW 8270	ug/kg	10				ND	ND	ND
Arom. C18H12 Hydrocarbon	SW 8270	ug/kg	10				ND	ND	ND
Benzopyrene Isomer	SW 8270	ug/kg	10				ND	ND	ND
Substituted Phenanthrene	SW 8270	ug/kg	10				ND	ND	ND
Oxygenated C14 Compound	SW 8270	ug/kg	10				ND	ND	ND
Carbazole (C12H9N)	SW 8270	ug/kg	10				ND	ND	ND
Dibenzothiophene (C12H8S)	SW 8270	ug/kg	10				ND	ND	ND
Nitrogenated Compound	SW 8270	ug/kg	1				ND	ND	ND
C18-C20 Hydrocarbon Matrix	SW 8270	ug/kg	1				ND	ND	ND
C25-C35 Hydrocarbon Matrix	SW 8270	ug/kg	1				ND	ND	ND
Methylene chloride	SW 8240	ug/kg	0.6				ND	ND	ND
Trichloroethylene	SW 8240	ug/kg	0.4				ND	ND	ND
Moisture in soil		Percent					9	14	12

* = Where no values are given, parameter is not regulated.

** = Quantification based upon comparison of total ion count of the compound with that of the nearest internal standard.

ND = Not detected.

— = Sample not analyzed for this parameter.

TABLE 4-8. ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT JRMHP (SITE 8)
DURING RI/FS, STAGE 2, AF PLANT 85
(Continued)

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels		Site Station Depth	8 MW7 6.6-7.5	8 MW7 19.8-20.5	8 MW7 34.8-35.5
				Federal	State	Sample Type Date Coll. Field No. Lab No.	DUP 000-012 10/19/88 005-S0-000-013 0010345+2	10/19/88 005-S0-000-014 0010345+3	10/24/88 005-S0-000-017 0010417+1
Silver	SW 0010	ng/kg	0.5						
Aluminum	SW 0010	ng/kg	5						
Barium	SW 0010	ng/kg	0.1						
Beryllium	SW 0010	ng/kg	0.00						
Calcium	SW 0010	ng/kg	0.3						
Cadmium	SW 0010	ng/kg	0.5						
Cobalt	SW 0010	ng/kg	1						
Chromium	SW 0010	ng/kg	1						
Copper	SW 0010	ng/kg	0.5						
Iron	SW 0010	ng/kg	0.5						
Potassium	SW 0010	ng/kg	20						
Magnesium	SW 0010	ng/kg	0.3						
Manganese	SW 0010	ng/kg	0.1						
Sodium	SW 0010	ng/kg	3						
Nickel	SW 0010	ng/kg	1						
Vanadium	SW 0010	ng/kg	0.0						
Zinc	SW 0010	ng/kg	0.0						
Mercury	SW 7471	ng/kg	0.4						
Acenaphthene	SW 0270	ng/kg	0.5				ND	ND	ND
Anthracene	SW 0270	ng/kg	0.5				ND	ND	ND
Benzo(a)anthracene	SW 0270	ng/kg	0.5				ND	ND	ND
Benzo(a)pyrene	SW 0270	ng/kg	0.5				ND	ND	ND
Benzo(b)fluoranthene	SW 0270	ng/kg	0.5				ND	ND	ND
Benzo(g,h,i)perylene	SW 0270	ng/kg	0.5				ND	ND	ND
Benzo(k)fluoranthene	SW 0270	ng/kg	0.5				ND	ND	ND
Chrysene	SW 0270	ng/kg	0.5				ND	ND	ND
Dibenzo(a,h)anthracene	SW 0270	ng/kg	0.5				ND	ND	ND
Dibenzo(f,h)anthracene	SW 0270	ng/kg	0.5				ND	ND	ND
Fluoranthene	SW 0270	ng/kg	0.5				ND	ND	ND
Fluorene	SW 0270	ng/kg	0.5				ND	ND	ND
Indeno(1,2,3-c,d)pyrene	SW 0270	ng/kg	0.5				ND	ND	ND
2-Methylnaphthalene	SW 0270	ng/kg	0.5				ND	ND	ND
Naphthalene	SW 0270	ng/kg	0.5				ND	ND	ND
N-Nitrosodiphenylamine	SW 0270	ng/kg	0.5				ND	ND	ND
Phenanthrene	SW 0270	ng/kg	0.5				ND	ND	ND
Pyrene	SW 0270	ng/kg	0.5				ND	ND	ND
Semi-Quantified SW 0270 Compounds									
C14H10O2 Compound	SW 0270	ng/kg	1				ND	ND	ND
C15H12 Hydrocarbon	SW 0270	ng/kg	1				ND	ND	ND
Area. CSH12 Hydrocarbon(1)	SW 0270	ng/kg	10				ND	ND	ND
Area. CSH12 Hydrocarbon(2)	SW 0270	ng/kg	10				ND	ND	ND
Area. C16 Hydrocarbon	SW 0270	ng/kg	10				ND	ND	ND
Area. C17H12 Hydrocarbon	SW 0270	ng/kg	10				ND	ND	ND
Area. C18H12 Hydrocarbon	SW 0270	ng/kg	10				ND	ND	ND
Benzo(a)pyrene Isomer	SW 0270	ng/kg	10				ND	ND	ND
Substituted Phenanthrene	SW 0270	ng/kg	10				ND	ND	ND
Brominated C14 Compound	SW 0270	ng/kg	10				ND	ND	ND
Carbazole (C12H8N2)	SW 0270	ng/kg	10				ND	ND	ND
Dibenzothiophene (C12H8S)	SW 0270	ng/kg	10				ND	ND	ND
Nitrogenated Compound	SW 0270	ng/kg	1				ND	ND	ND
C16-C20 Hydrocarbon Matrix	SW 0270	ng/kg	1				ND	5	5
C25-C35 Hydrocarbon Matrix	SW 0270	ng/kg	1				ND	ND	ND
Methylene chloride	SW 0240	ng/kg	0.0				ND	ND	ND
Trichloroethylene	SW 0240	ng/kg	0.4				ND	ND	ND
Moisture in soil		Percent					12	13	9

• = Where no values are given, parameter is not regulated.

•• = Quantification based upon comparison of total ion count of the compound with that of the nearest internal standard.

ND = Not detected.

— = Sample not analyzed for this parameter.

TABLE 4-9. ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT JRHWP (SITE 8)
DURING RI/FS, STAGE 2, AF PLANT 86
(Continued)

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels*		Site Station	8 MW7	8 MW8	8 MW8
				Federal	State	Depth Sample Type Date Coll. Field No. Lab No.	8 MW7 10/24/88 885-SO-008-018 8810417+3	8 MW8 4.0-5.5 10/19/88 885-SO-008-015 8810345+4	8 MW8 14.0-15.5 10/19/88 885-SO-008-016 8810345+6
Silver	SW 6010	ag/kg	0.5				---	---	---
Aluminum	SW 6010	ag/kg	5				---	---	---
Barium	SW 6010	ag/kg	0.1				---	---	---
Beryllium	SW 6010	ag/kg	0.03				---	---	---
Calcium	SW 6010	ag/kg	0.3				---	---	---
Cadmium	SW 6010	ag/kg	0.5				---	---	---
Cobalt	SW 6010	ag/kg	1				---	---	---
Chromium	SW 6010	ag/kg	1				---	---	---
Copper	SW 6010	ag/kg	0.5				---	---	---
Iron	SW 6010	ag/kg	0.5				---	---	---
Potassium	SW 6010	ag/kg	20				---	---	---
Magnesium	SW 6010	ag/kg	0.3				---	---	---
Manganese	SW 6010	ag/kg	0.1				---	---	---
Sodium	SW 6010	ag/kg	3				---	---	---
Nickel	SW 6010	ag/kg	1				---	---	---
Vanadium	SW 6010	ag/kg	0.0				---	---	---
Zinc	SW 6010	ag/kg	0.0				---	---	---
Mercury	SW 7471	ag/kg	0.4				---	---	---
Acenaphthene	SW 8270	ag/kg	0.5				---	ND	ND
Anthracene	SW 8270	ag/kg	0.5				---	ND	ND
Benzo(a)anthracene	SW 8270	ag/kg	0.5				---	1.4	ND
Benzo(a)pyrene	SW 8270	ag/kg	0.5				---	0.9	ND
Benzo(b)fluoranthene	SW 8270	ag/kg	0.5				---	1	ND
Benzo(g,h,i)perylene	SW 8270	ag/kg	0.5				---	0.7	ND
Benzo(k)fluoranthene	SW 8270	ag/kg	0.5				---	1	ND
Chrysene	SW 8270	ag/kg	0.5				---	1.2	ND
Dibenzo(a,h)anthracene	SW 8270	ag/kg	0.5				---	ND	ND
Dibenzofuran	SW 8270	ag/kg	0.5				---	ND	ND
Fluoranthene	SW 8270	ag/kg	0.5				---	3.1	ND
Fluorene	SW 8270	ag/kg	0.5				---	ND	ND
Indeno(1,2,3-c,d)pyrene	SW 8270	ag/kg	0.5				---	0.6	ND
2-Methylnaphthalene	SW 8270	ag/kg	0.5				---	ND	ND
Naphthalene	SW 8270	ag/kg	0.5				---	ND	ND
N-Nitrosodiphenylamine	SW 8270	ag/kg	0.5				---	ND	ND
Phenanthrene	SW 8270	ag/kg	0.5				---	1.5	ND
Pyrene	SW 8270	ag/kg	0.5				---	2.2	ND
Semi-Quantified SW 8270 Compounds**									
C14H8O2 Compound	SW 8270	ag/kg	1				---	ND	ND
C15H10 Hydrocarbon	SW 8270	ag/kg	1				---	ND	ND
Arom. C5H12 Hydrocarbon(1)	SW 8270	ag/kg	10				---	ND	ND
Arom. C5H12 Hydrocarbon(2)	SW 8270	ag/kg	10				---	ND	ND
Arom. C16 Hydrocarbon	SW 8270	ag/kg	10				---	ND	ND
Arom. C17H12 Hydrocarbon	SW 8270	ag/kg	10				---	ND	ND
Arom. C18H12 Hydrocarbon	SW 8270	ag/kg	10				---	ND	ND
Benzopyrene Isomer	SW 8270	ag/kg	10				---	ND	ND
Substituted Phenanthrene	SW 8270	ag/kg	10				---	ND	ND
Oxygenated C14 Compound	SW 8270	ag/kg	10				---	ND	ND
Carbazole (C12H9N)	SW 8270	ag/kg	10				---	ND	ND
Dibenzothiophene (C12H8S)	SW 8270	ag/kg	10				---	ND	ND
Nitrogenated Compound	SW 8270	ag/kg	1				---	ND	ND
C10-C20 Hydrocarbon Matrix	SW 8270	ag/kg	1				---	ND	10
C25-C35 Hydrocarbon Matrix	SW 8270	ag/kg	1				---	ND	ND
Methylene chloride	SW 8240	ag/kg	0.0				ND	ND	ND
Trichloroethylene	SW 8240	ag/kg	0.4				ND	ND	ND
Moisture in soil		Percent					---	12	18

* = Where no values are given, parameter is not regulated.

** = Quantification based upon comparison of total ion count of the compound with that of the nearest internal standard.

ND = Not detected.

--- = Sample not analyzed for this parameter.

TABLE 4-9. ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT JMWHP (SITE 8)
DURING RI/FS, STAGE 2, AF PLANT 85
(Continued)

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels		Site Station Depth	8 M88 34.8-35.5	8 M88 --
				Federal	State	Sample Type Date Coll. Field No. Lab No.	18/25/88 005-S0-000-019 0010417+2	Trip Blank 18/25/88 005-S0-000-020 0010417+4
Silver	SW 0010	ng/kg	0.5					
Aluminum	SW 0010	ng/kg	5					
Barium	SW 0010	ng/kg	0.1					
Beryllium	SW 0010	ng/kg	0.03					
Calcium	SW 0010	ng/kg	0.3					
Cadmium	SW 0010	ng/kg	0.5					
Cobalt	SW 0010	ng/kg	1					
Chromium	SW 0010	ng/kg	1					
Copper	SW 0010	ng/kg	0.5					
Iron	SW 0010	ng/kg	0.5					
Potassium	SW 0010	ng/kg	20					
Magnesium	SW 0010	ng/kg	0.3					
Manganese	SW 0010	ng/kg	0.1					
Sodium	SW 0010	ng/kg	3					
Nickel	SW 0010	ng/kg	1					
Vanadium	SW 0010	ng/kg	0.8					
Zinc	SW 0010	ng/kg	0.3					
Mercury	SW 7471	ng/kg	0.4					
Acenaphthene	SW 0270	ng/kg	0.5				ND	
Anthracene	SW 0270	ng/kg	0.5				ND	
Benzo(a)anthracene	SW 0270	ng/kg	0.5				ND	
Benzo(a)pyrene	SW 0270	ng/kg	0.5				ND	
Benzo(b)fluoranthene	SW 0270	ng/kg	0.5				ND	
Benzo(g,h,i)perylene	SW 0270	ng/kg	0.5				ND	
Benzo(k)fluoranthene	SW 0270	ng/kg	0.5				ND	
Chrysene	SW 0270	ng/kg	0.5				ND	
Dibenzo(a,h)anthracene	SW 0270	ng/kg	0.5				ND	
Dibenzofuran	SW 0270	ng/kg	0.5				ND	
Fluoranthene	SW 0270	ng/kg	0.5				ND	
Fluorene	SW 0270	ng/kg	0.5				ND	
Indeno(1,2,3-c,d)pyrene	SW 0270	ng/kg	0.5				ND	
2-Methylnaphthalene	SW 0270	ng/kg	0.5				ND	
Naphthalene	SW 0270	ng/kg	0.5				ND	
N-Nitrosodiphenylamine	SW 0270	ng/kg	0.5				ND	
Phenanthrene	SW 0270	ng/kg	0.5				ND	
Pyrene	SW 0270	ng/kg	0.5				ND	
Semi-Quantified SW 0270 Compounds								
C14H10 Compound	SW 0270	ng/kg	1				ND	
C15H12 Hydrocarbon	SW 0270	ng/kg	1				ND	
Aro. C16H12 Hydrocarbon(1)	SW 0270	ng/kg	10				ND	
Aro. C16H12 Hydrocarbon(2)	SW 0270	ng/kg	10				ND	
Aro. C16 Hydrocarbon	SW 0270	ng/kg	10				ND	
Aro. C17H12 Hydrocarbon	SW 0270	ng/kg	10				ND	
Aro. C18H12 Hydrocarbon	SW 0270	ng/kg	10				ND	
Benzo(a)pyrene Isomer	SW 0270	ng/kg	10				ND	
Substituted Phenanthrene	SW 0270	ng/kg	10				ND	
Oxygenated C14 Compound	SW 0270	ng/kg	10				ND	
Carbazole (C12H8N2)	SW 0270	ng/kg	10				ND	
Dibenzothiophene (C12H8S)	SW 0270	ng/kg	10				ND	
Nitrogenated Compound	SW 0270	ng/kg	1				ND	
C18-C20 Hydrocarbon Matrix	SW 0270	ng/kg	1				ND	
C25-C35 Hydrocarbon Matrix	SW 0270	ng/kg	1				ND	
Methylene chloride	SW 0240	ng/kg	0.8				ND	ND
Trichloroethylene	SW 0240	ng/kg	0.4				ND	ND
Moisture in soil		Percent					11	

o = Where no values are given, parameter is not regulated.

oo = Quantification based upon comparison of total ion count of the compound with that of the nearest internal standard.

ND = Not detected.

-- = Sample not analyzed for this parameter.

TABLE 4-10
ANALYTICAL DATA FOR GROUNDWATER SAMPLES COLLECTED AT FOTA (SITE 4)
DURING PHASE II, STAGE 1, AF PLANT 85

Parameter	Method	Units	Detection Limits	Standards and Action Levels(a)	Site			
					Federal	State	Station	
							Sample Type Date Coll. Field No. Lab No.	PG 401 -- 3/7/86 GP-86-4004 FJ-407
*Total Dissolved Solids	E 100.1	mg/L	1	500.0 500.0	486	481	311	500
*Sulfate	E 300	mg/L	0.0005	250.0 250.0	—	—	—	—
Arsenic	E 200.2	mg/L	0.0034	0.05 0.05	—	—	—	—
Cadmium, Total	E 213.2	mg/L	0.0001	0.01 0.01	—	—	—	—
Cadmium, Dissolved	E 213.2	mg/L	0.0001	0.01 0.01	—	—	—	—
Chromium, Total	E 210.2	mg/L	0.001	—	—	—	—	—
Chromium, Dissolved	E 210.2	mg/L	0.001	—	—	—	—	—
*Copper	E 210.2	mg/L	0.0003	1.0 1.0	—	—	—	—
Lead, Total	E 210.2	mg/L	0.0003	0.05 0.05	—	—	—	—
Lead, Dissolved	E 210.2	mg/L	0.0003	0.05 (0.005) 0.05	0.007	—	0.003	0.007
*Manganese	E 243.2	mg/L	0.0003	0.05 0.05	—	—	—	—
Nickel, Total	E 249.2	mg/L	0.001	—	—	—	—	—
Nickel, Dissolved	E 249.2	mg/L	0.001	—	—	—	—	—
*Zinc	E 200.1	mg/L	0.002	5.0 5.0	—	—	—	—
Total Organic Carbon	E 415.1	mg/L	0.005	—	1.0	5.0	4.4	6.0
Total Organic Halides	SW 9020	ug/L	10	—	ND	—	12.0	ND
Oil and Grease	E 413.2	mg/l	0.1	—	1.0	—	0.5	1.0
1,1,1-Trichloroethane	E 601	ug/L	1	200.0 200.0	ND	—	ND	ND
Chloroform	E 601	ug/L	1	100.0 * 100.0 *	ND	—	ND	ND
Aromatic VOCs	E 602	ug/L	1	—	ND	—	ND	ND

* = Parameters with secondary maximum contaminant levels for standards.

(a) = Where no values are given, parameter is not regulated.

ND = Not detected.

U = Sample not analyzed for this parameter.

T = Standards listed in parentheses are proposed Federal MCLs with the final rule expected in 1990.

* = For total trihalomethanes group.

TABLE 4-11
ANALYTICAL DATA FOR GROUNDWATER SAMPLES COLLECTED AT FOTA (SITE 4)
DURING RI/F3, STAGE 2, AF PLANT 05

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels(a)	Site				4			
					Federal	State	Sample Type Date Coll.	Equip blank 12/00/00	PG 401 12/00/00	AC blank 2 12/00/00	PG 401 12/00/00	Trip blank 12/00/00
					Field No.	Lab No.						
Total Dissolved Solids	E100.1	mg/L	10	500.0 500.0	21							
Chloride	E300	mg/L	0.5	250.0 250.0	ND							
Fluoride	E300	mg/L	0.5	4.0 4.0	ND							
Sulfate	E300	mg/L	1.0	250.0 250.0	ND							
Antimony	SW 0010	mg/L	0.3		ND							
Barium	SW 0010	mg/L	0.004	1.0(5.0) 1.0	0.005							
Beryllium	SW 0010	mg/L	0.001		ND							
Cadmium	SW 0010	mg/L	0.2	0.01(0.005) 0.01	ND							
Calcium	SW 0010	mg/L	0.01		0.1							
Cobalt	SW 0010	mg/L	0.04		ND							
Copper	SW 0010	mg/L	0.02	1.0(1.3) 1.0	ND							
Iron	SW 0010	mg/L	0.02	0.3 0.3	0.04							
Magnesium	SW 0010	mg/L	0.01		0.01							
Manganese	SW 0010	mg/L	0.005	0.05 0.05	ND							
Molybdenum	SW 0010	mg/L	0.2		ND							
Nickel	SW 0010	mg/L	0.04		ND							
Potassium	SW 0010	mg/L	0.0		ND							
Silver	SW 0010	mg/L	0.02	0.05(+) 0.05	ND							
Sodium	SW 0010	mg/L	0.1		0.4							
Zinc	SW 0010	mg/L	0.03	5.0 5.0	ND							
Arsenic	SW 7000	mg/L	0.002	0.05 0.05	ND							
Lead	SW 7421	mg/L	0.002	0.05(0.005) 0.05	ND							
Mercury	SW 7470	mg/L	0.0000	0.002 0.002	ND							
1,1,1-Trichloroethane	SW 0010	ug/L	0.5	200.0 200.0	ND							
Broodichloroethane	SW 0010	ug/L	0.5	100.0 + 100.0 +	ND							
Chloroform	SW 0010	ug/L	0.2	100.0 + 100.0 +	ND							
Dibromochloroethane	SW 0010	ug/L	0.5	100.0 + 100.0 +	ND							
Freon 113	SW 0010	ug/L	0.5		ND							
Methylene chloride	SW 0010	ug/L	2		ND							
Trichloroethylene	SW 0010	ug/L	0.5	5.0 5.0	ND							
Toluene	SW 0020	ug/L	0.5	(2000.0)	ND							
Semivolatile Organics	SW 0270	ug/L			ND							

(a) = Where no values are given, parameter is not regulated.

• = Parameters with secondary maximum contaminant levels for standards.

ND = Not detected.

• = Sample not analyzed for this parameter.

TJ = Standards listed in parentheses are proposed Federal MCLs with the final rule expected in 1990.

• = For total trihalomethanes group.

TABLE 4-11

ANALYTICAL DATA FOR GROUNDWATER SAMPLES COLLECTED AT FDTA (SITE 4)
DURING RI/FS, STAGE 2, AF PLANT 85
(Continued)

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels(s) ----- Federal State	Site				4MW4 2nd Column 12/01/88 085-GW-004-001 085-GW-004-001 0812030+5
					Station		4MW4		
					Sample Type	4MW4	1st Column	4MW4	
					Date Coll.	12/07/88	12/01/88	12/01/88	

(a) = Where no values are given, parameter is not regulated.

* = Parameters with secondary maximum contaminant levels for standards.

ND = Not detected.

† = Sample not analyzed for this parameter.

() = Standards listed in parentheses are proposed Federal MCLs with the final rule expected in 1990.

* = For total trihalomethanes group.

TABLE 4-12

ANALYTICAL DATA FOR GROUNDWATER SAMPLES COLLECTED AT JMWHP (SITE 9)
DURING PHASE II, STAGE 1, AF PLANT 66

Parameter	Method	Units	Detection Limits	Method	Standards and Action Levels(a)		Site					PO 001	PO 002	PO 003	PO 003	PO 003	PO 003
					Federal	State	Sample Type	Date Coll.	Field No.	Lab No.							
Total Dissolved Solids	E 100.1	mg/L	1		500.0	500.0	523										
Sulfate	E 300	mg/L	0.0005		250.0	250.0							400		492		
Arsenic	E 200.2	mg/L	0.0034		0.05	0.05											
Cadmium, Total	E 213.2	mg/L	0.0001		0.01(0.005)	0.01											
Cadmium, Dissolved	E 213.2	mg/L	0.0001		0.01(0.005)	0.01											
Chromium, Total	E 210.2	mg/L	0.001														
Chromium, Dissolved	E 210.2	mg/L	0.001														
Copper	E 220.2	mg/L	0.0012		1.0(1.3)	1.0											
Lead, Total	E 230.2	mg/L	0.0005		0.05(0.005)	0.05											
Lead, Dissolved	E 230.2	mg/L	0.0005		0.05(0.005)	0.05											
Manganese	E 243.2	mg/L	0.0003		0.05	0.05											
Nickel, Total	E 249.2	mg/L	0.001														
Nickel, Dissolved	E 249.2	mg/L	0.001														
Zinc	E 200.1	mg/L	0.002		5.0	5.0											
Total Organic Carbon	E 415.1	mg/L	0.005				1.0					0.0	4.5		4.5		
Total Organic Halides	SW 9020	ug/L	10				ND				ND	22.0		1022			
Oil and Grease	E 413.2	mg/l	0.1				0.0					0.7		0.5			
1,1,1-Trichloroethane	E 601	ug/L	1		200.0	200.0	ND				ND	ND		ND		ND	ND
Chloroform	E 601	ug/L	1		100.0	100.0	ND				ND	ND		ND		ND	ND
Aromatic VOCs	E 602	ug/L	1				ND				ND	ND		ND		ND	ND

* = Parameters with secondary maximum contaminant levels for standards.

(a) = Where no values are given, parameter is not regulated.

ND = Not detected.

-- = Sample not analyzed for the parameters.

() = Samples listed in parentheses are proposed Federal MCLs with final rule expected in 1990.

* = For total trihalomethanes group.

ANALYTICAL DATA FOR GROUNDWATER SAMPLES COLLECTED AT JRHWP (SITE 8)
DURING RI/FS, STAGE 2, AF PLANT 85

2/1/90 44-13

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels(s)		Site				PG 803 1st Column 12/02/88 085-GW-008-009 0812050+4
				Federal	State	Station Sample Type Date Coll.	PG 801 -- 12/02/88 085-GW-008-009 0812050+1	1st Column 12/02/88 085-GW-008-009 0812050+2	PG 802 2nd Column 12/02/88 085-GW-008-009 0812050+11	
*Total Dissolved Solids	E180.1	mg/L	10	500.0	500.0		600	610		650
*Chloride	E300	mg/L	0.5	250.0	250.0		39	22		4
*Fluoride	E300	mg/L	0.5	4.0	4.0		ND	0.9		ND
*Sulfate	E300	mg/L	1.0	250.0	250.0		59	64		81
Antimony	SW 6010	mg/L	0.3				ND	ND		ND
Barium	SW 6010	mg/L	0.004	1.0(5.0)	1.0		0.16	0.095		0.13
Beryllium	SW 6010	mg/L	0.001				ND	ND		ND
Cadmium	SW 6010	mg/L	0.2	0.01(0.005)	0.01		100	91		120
Calcium	SW 6010	mg/L	0.01				ND	ND		ND
Cobalt	SW 6010	mg/L	0.04				ND	ND		ND
Copper	SW 6010	mg/L	0.02	1.0(1.3)	1.0		ND	ND		ND
*Iron	SW 6010	mg/L	0.02	0.3	0.3		0.13	0.06		0.19
*Magnesium	SW 6010	mg/L	0.01				40	42		44
Manganese	SW 6010	mg/L	0.005	0.05	0.05		0.11	0.09		0.34
Molybdenum	SW 6010	mg/L	0.2				ND	0.3		0.4
Nickel	SW 6010	mg/L	0.04				ND	ND		ND
Potassium	SW 6010	mg/L	0.6				2.3	17		ND
Silver	SW 6010	mg/L	0.02	0.05 (+)	0.05		ND	ND		ND
Sodium	SW 6010	mg/L	0.1				11	17		7.5
*Zinc	SW 6010	mg/L	0.03	5.0	5.0		0.06	0.08		0.06
Arsenic	SW 7000	mg/L	0.002	0.05	0.05		ND	ND		ND
Lead	SW 7421	mg/L	0.002	0.05(0.005)	0.05		ND	ND		ND
Mercury	SW 7470	mg/L	0.0000	0.002	0.002		ND	ND		ND
✓ 1,1,1-Trichloroethane	SW 8010	ug/L	0.5	200.0	200.0		ND	0.7	1.2	ND
Bromodichloromethane	SW 8010	ug/L	0.5	100.0 +	100.0 +		ND	ND	ND	ND
Chloroform	SW 8010	ug/L	0.2	100.0 +	100.0 +		ND	ND	ND	ND
Dibromochloromethane	SW 8010	ug/L	0.5	100.0 +	100.0 +		ND	ND	ND	ND
Freon 113	SW 8010	ug/L	0.5	100.0 +	100.0 +		ND	ND	ND	5900
Methylene chloride	SW 8010	ug/L	2				ND	ND	ND	ND
Trichloroethylene	SW 8010	ug/L	0.5	5.0	5.0		ND	ND	ND	ND
Toluene	SW 8020	ug/L	0.5	(2000.0)			ND	ND		ND
Semivolatile Organics	SW 8270	ug/L					ND	ND		ND

(a) = Where no values are given, parameter is not regulated.

* = Parameters with secondary maximum contaminant levels for standards.

** = Sample 085-GW-008-009 was diluted fifty fold due to the presence of Freon 113. This compound confirmed and quantified.

ND = Not detected.

= Sample not analyzed for this parameter.

(T) = Standards listed in parentheses are proposed Federal MCLs with the final rule expected in 1990.

* = For total trihalomethanes group.

TABLE 4-13

ANALYTICAL DATA FOR GROUNDWATER SAMPLES COLLECTED AT JMWHP (SITE 8)
DURING RI/FS, STAGE 2, AF PLANT 85
(Continued)

Parameter	Method	Units	Detection Limit	Standards and Action Levels(a)				Site				Lab No.
				Federal	State	Method	Detection Limit	Sample Type	Date Coll.	2nd Column	QM74	QM74
*Total Dissolved Solids	E100.1	mg/L	10	500.0	500.0				11/29/85	11/29/85	11/29/85	11/29/85
*Chloride	E300	mg/L	0.5	250.0	250.0				11/29/85	11/29/85	11/29/85	11/29/85
*Fluoride	E300	mg/L	0.5	4.0	4.0				11/29/85	11/29/85	11/29/85	11/29/85
*Sulfate	E300	mg/L	1.0	250.0	250.0				11/29/85	11/29/85	11/29/85	11/29/85
Antimony	SW 6010	mg/L	0.3						11/29/85	11/29/85	11/29/85	11/29/85
Barium	SW 6010	mg/L	0.004	1.0(5.0)	1.0				11/29/85	11/29/85	11/29/85	11/29/85
Beryllium	SW 6010	mg/L	0.001						11/29/85	11/29/85	11/29/85	11/29/85
Cadmium	SW 6010	mg/L	0.2	0.01(0.005)	0.01				11/29/85	11/29/85	11/29/85	11/29/85
Calcium	SW 6010	mg/L	0.01						11/29/85	11/29/85	11/29/85	11/29/85
Cobalt	SW 6010	mg/L	0.04						11/29/85	11/29/85	11/29/85	11/29/85
Copper	SW 6010	mg/L	0.02	1.0(1.3)	1.0				11/29/85	11/29/85	11/29/85	11/29/85
*Iron	SW 6010	mg/L	0.02	0.3	0.3				11/29/85	11/29/85	11/29/85	11/29/85
*Magnesium	SW 6010	mg/L	0.01						11/29/85	11/29/85	11/29/85	11/29/85
Manganese	SW 6010	mg/L	0.005	0.05	0.05				11/29/85	11/29/85	11/29/85	11/29/85
Molybdenum	SW 6010	mg/L	0.2						11/29/85	11/29/85	11/29/85	11/29/85
Nickel	SW 6010	mg/L	0.04						11/29/85	11/29/85	11/29/85	11/29/85
Potassium	SW 6010	mg/L	0.0						11/29/85	11/29/85	11/29/85	11/29/85
Silver	SW 6010	mg/L	0.02	0.05 (*)	0.05				11/29/85	11/29/85	11/29/85	11/29/85
Sodium	SW 6010	mg/L	0.1						11/29/85	11/29/85	11/29/85	11/29/85
*Zinc	SW 6010	mg/L	0.03	5.0	5.0				11/29/85	11/29/85	11/29/85	11/29/85
Arsenic	SW 7060	mg/L	0.002	0.05	0.05				11/29/85	11/29/85	11/29/85	11/29/85
Lead	SW 7421	mg/L	0.002	0.05(0.005)	0.05				11/29/85	11/29/85	11/29/85	11/29/85
Mercury	SW 7470	mg/L	0.0000	0.002	0.002				11/29/85	11/29/85	11/29/85	11/29/85
1,1,1-Trichloroethane	SW 8010	ug/L	0.5	200.0	200.0				11/29/85	11/29/85	11/29/85	11/29/85
Bromodichloroethane	SW 8010	ug/L	0.5	100.0 *	100.0 *				11/29/85	11/29/85	11/29/85	11/29/85
Chloroform	SW 8010	ug/L	0.2	100.0 *	100.0 *				11/29/85	11/29/85	11/29/85	11/29/85
Dibromochloroethane	SW 8010	ug/L	0.5	100.0 *	100.0 *				11/29/85	11/29/85	11/29/85	11/29/85
Freon 113	SW 8010	ug/L	0.5	100.0 *	100.0 *				11/29/85	11/29/85	11/29/85	11/29/85
Methylene chloride	SW 8010	ug/L	2						11/29/85	11/29/85	11/29/85	11/29/85
Trichloroethylene	SW 8010	ug/L	0.5	5.0	5.0				11/29/85	11/29/85	11/29/85	11/29/85
Toluene	SW 8020	ug/L	0.5	(2000.0)					11/29/85	11/29/85	11/29/85	11/29/85
Semivolatile Organics	SW 8270	ug/L							11/29/85	11/29/85	11/29/85	11/29/85

(a) = Where no values are given, parameter is not regulated.

* = Parameters with secondary maximum contaminant levels for standards.

** = Sample 885-QW-888-889 was diluted fifty fold due to the presence of Freon 113. This compound confirmed and quantified.

ND = Not detected.

† = Sample not analyzed for this parameter.

() = Standards listed in parentheses are proposed Federal MCLs with the final rule expected in 1990.

* = For total trihalomethanes group.

ANALYTICAL DATA FOR GROUNDWATER SAMPLES COLLECTED AT JRHP (SITE 8)
DURING RI/FS, STAGE 2, AF PLANT 85
(Continued)

Parameter	Method	Units	Method Detection Limit	Site				
				Standards and Action Levels(a)				
				Federal	State	8MW4 Equip Blank 2 11/30/88 885-GW-008-003	8MW4 Trip Blank 11/30/88 885-GW-008-004	8MW4 AC Blank 1 11/30/88 885-GW-008-005
*Total Dissolved Solids	E100.1	mg/L	10	500.0	500.0	8812995+9	8812995+4	8812995+6
*Chloride	E300	mg/L	0.5	250.0	250.0	8812995+9	8812995+4	8812995+6
*Fluoride	E300	mg/L	0.5	4.0	4.0	8812995+9	8812995+4	8812995+6
*Sulfate	E300	mg/L	1.0	250.0	250.0	8812995+9	8812995+4	8812995+6
Antimony	SW 0010	mg/L	0.3			8812995+9	8812995+4	8812995+6
Barium	SW 0010	mg/L	0.004	1.0(5.0)	1.0	8812995+9	8812995+4	8812995+6
Beryllium	SW 0010	mg/L	0.001			8812995+9	8812995+4	8812995+6
Cadmium	SW 0010	mg/L	0.2	0.01(0.005)	0.01	8812995+9	8812995+4	8812995+6
Calcium	SW 0010	mg/L	0.01			8812995+9	8812995+4	8812995+6
Cobalt	SW 0010	mg/L	0.04			8812995+9	8812995+4	8812995+6
Copper	SW 0010	mg/L	0.02	1.0(1.3)	1.0	8812995+9	8812995+4	8812995+6
*Iron	SW 0010	mg/L	0.02	0.3	0.3	8812995+9	8812995+4	8812995+6
*Magnesium	SW 0010	mg/L	0.01			8812995+9	8812995+4	8812995+6
Manganese	SW 0010	mg/L	0.005	0.05	0.05	8812995+9	8812995+4	8812995+6
Molybdenum	SW 0010	mg/L	0.2			8812995+9	8812995+4	8812995+6
Nickel	SW 0010	mg/L	0.04			8812995+9	8812995+4	8812995+6
Potassium	SW 0010	mg/L	0.6			8812995+9	8812995+4	8812995+6
Silver	SW 0010	mg/L	0.02	0.05 (*)	0.05	8812995+9	8812995+4	8812995+6
Sodium	SW 0010	mg/L	0.1			8812995+9	8812995+4	8812995+6
*Zinc	SW 0010	mg/L	0.03	5.0	5.0	8812995+9	8812995+4	8812995+6
Arsenic	SW 7000	mg/L	0.002	0.05	0.05	8812995+9	8812995+4	8812995+6
Lead	SW 7421	mg/L	0.002	0.05(0.005)	0.05	8812995+9	8812995+4	8812995+6
Mercury	SW 7470	mg/L	0.0000	0.002	0.002	8812995+9	8812995+4	8812995+6
1,1,1-Trichloroethane	SW 8010	ug/L	0.5	200.0	200.0	8812995+9	8812995+4	8812995+6
Bromodichloroethane	SW 8010	ug/L	0.5	100.0 +	100.0 +	8812995+9	8812995+4	8812995+6
Chloroform	SW 8010	ug/L	0.2	100.0 +	100.0 +	8812995+9	8812995+4	8812995+6
Dibromochloromethane	SW 8010	ug/L	0.5	100.0 +	100.0 +	8812995+9	8812995+4	8812995+6
Freon 113	SW 8010	ug/L	0.5			8812995+9	8812995+4	8812995+6
Methylene chloride	SW 8010	ug/L	2			8812995+9	8812995+4	8812995+6
Trichloroethylene	SW 8010	ug/L	0.5	5.0	5.0	8812995+9	8812995+4	8812995+6
Toluene	SW 8020	ug/L	0.5	(2000.0)		8812995+9	8812995+4	8812995+6
Semi-volatile Organics	SW 8270	ug/L				8812995+9	8812995+4	8812995+6

(a) = Where no values are given, parameter is not regulated.

* = Parameters with secondary maximum contaminant levels for standards.

** = Sample 885-GW-008-009 was diluted fifty fold due to the presence of Freon 113. This compound confirmed and quantified.

ND = Not detected.

= Sample not analyzed for this parameter.

U = Standards listed in parentheses are proposed Federal MCLs with the final rule expected in 1998.

* = For total trihaloethanes group.

TABLE 4-13
ANALYTICAL DATA FOR GROUNDWATER SAMPLES COLLECTED AT JMWSP (SITE 8)
DURING RI/FS, STAGE 2, AF PLANT 86
(Continued)

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels(a)		Site			
				Federal	State	Station		Date	
						Sample Type	Lab No.	Field No.	Lab No.
• Total Dissolved Solids	E100.1	mg/L	10	500.0	500.0	SW 0010	001205003	001207302	001207301
• Chloride	E300	mg/L	0.5	250.0	250.0	SW 0010	001205003	001207302	001207301
• Fluoride	E300	mg/L	0.5	4.0	4.0	SW 0010	001205003	001207302	001207301
• Sulfate	E300	mg/L	1.0	250.0	250.0	SW 0010	001205003	001207302	001207301
Antimony	SW 0010	mg/L	0.3	1.0(5.0)	1.0	SW 0010	001205003	001207302	001207301
Barium	SW 0010	mg/L	0.004			SW 0010	001205003	001207302	001207301
Beryllium	SW 0010	mg/L	0.001			SW 0010	001205003	001207302	001207301
Cadmium	SW 0010	mg/L	0.2	0.01(0.005)	0.01	SW 0010	001205003	001207302	001207301
Calcium	SW 0010	mg/L	0.01			SW 0010	001205003	001207302	001207301
Cobalt	SW 0010	mg/L	0.04			SW 0010	001205003	001207302	001207301
Copper	SW 0010	mg/L	0.02	1.0(1.3)	1.0	SW 0010	001205003	001207302	001207301
• Iron	SW 0010	mg/L	0.02	0.3	0.3	SW 0010	001205003	001207302	001207301
• Magnesium	SW 0010	mg/L	0.01			SW 0010	001205003	001207302	001207301
Manganese	SW 0010	mg/L	0.005	0.05	0.05	SW 0010	001205003	001207302	001207301
Molybdenum	SW 0010	mg/L	0.2			SW 0010	001205003	001207302	001207301
Nickel	SW 0010	mg/L	0.04			SW 0010	001205003	001207302	001207301
Potassium	SW 0010	mg/L	0.0			SW 0010	001205003	001207302	001207301
Silver	SW 0010	mg/L	0.02	0.05 (*)	0.05	SW 0010	001205003	001207302	001207301
Sodium	SW 0010	mg/L	0.1			SW 0010	001205003	001207302	001207301
• Zinc	SW 0010	mg/L	0.03	5.0	5.0	SW 0010	001205003	001207302	001207301
Arsenic	SW 7000	mg/L	0.002	0.05	0.05	SW 7000	001205003	001207302	001207301
Lead	SW 7421	mg/L	0.002	0.05(0.005)	0.05	SW 7421	001205003	001207302	001207301
Mercury	SW 7470	mg/L	0.0000	0.002	0.002	SW 7470	001205003	001207302	001207301
1,1,1-Trichloroethane	SW 0010	ug/L	0.5	200.0	200.0	SW 0010	001205003	001207302	001207301
Bromodichloromethane	SW 0010	ug/L	0.5	100.0 *	100.0 *	SW 0010	001205003	001207302	001207301
Chloroform	SW 0010	ug/L	0.2	100.0 *	100.0 *	SW 0010	001205003	001207302	001207301
Dibromochloromethane	SW 0010	ug/L	0.5	100.0 *	100.0 *	SW 0010	001205003	001207302	001207301
Freon 113	SW 0010	ug/L	0.5			SW 0010	001205003	001207302	001207301
Methylene chloride	SW 0010	ug/L	2			SW 0010	001205003	001207302	001207301
Trichloroethylene	SW 0010	ug/L	0.5	5.0	5.0	SW 0010	001205003	001207302	001207301
Toluene	SW 0020	ug/L	0.5	(2000.0)		SW 0020	001205003	001207302	001207301
Semivolatile Organics	SW 8270	ug/L				SW 8270	001205003	001207302	001207301

(a) = Where no values are given, parameter is not regulated.
 * = Parameters with secondary maximum contaminant levels for standards.
 ** = Sample 005-CW-000-009 was diluted fifty fold due to the presence of Freon 113. This compound confirmed and quantified.
 ND = Not detected.
 (T) = Sample not analyzed for this parameter.
 * = Standards listed in parentheses are proposed Federal MCLs with the final rule expected in 1990.
 * = For total trihaloethanes group.

mg/kg. It was also found in one groundwater sample from monitoring well PG802 (0.7 µg/L). 1,1-Dichloroethane (1,1-DCA) and 1,2-DCA, breakdown products of 1,1,1-TCA, were also detected in soil samples from this combined site. 1,1-DCA was detected in soil from monitoring well PG801 (0.0062 mg/kg), while 1,2-DCA was detected in soil samples from monitoring wells PG401, PG402, PG403, PG801, PG803 and borehole S0403 in concentrations ranging from 0.0078 to 1.9 mg/kg.

1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113) was detected in well PG803 at a concentration of 5.9 mg/L, but was not detected in any of the soil samples at this combined site.

During Stage 1, toluene and methylene chloride were detected in soil samples from all the boreholes and monitoring wells, with concentrations ranging from 0.018 to 0.19 mg/kg and from 0.026 to 0.204 mg/kg, respectively. Toluene and methylene chloride were not detected in any soil samples collected during this Stage 2 investigation. These analytes were not detected in any of the groundwater samples.

During Stage 2, quantities of benzo(a)anthracene (1.4 mg/kg), benzo(a)pyrene (0.9 mg/kg), benzo(b)fluoranthene (1.0 mg/kg), benzo(g,h,i)perylene (0.7 mg/kg), benzo(k)fluoranthene (1.0 mg/kg), chrysene (1.2 mg/kg), fluoranthene (3.1 mg/kg), indeno(1,2,3-c,d)pyrene (0.6 mg/kg), phenanthrene (1.5 mg/kg), and pyrene (2.2 mg/kg) were detected in a soil sample taken from borehole 8MW8 at 4.0 to 5.5 feet bgs. These compounds are classified as polynuclear or polycyclic aromatic hydrocarbons (PAHs).

Oil and grease were found in all soil samples collected during the Stage 1 investigation, with concentrations ranging from 24.5 to 210 mg/kg. During Stage 2, oil and grease were detected as semi-quantified SW 8270 compounds, C25-C35 hydrocarbon matrix in soils samples from wells 4MW4 and 8MW4 (80 to 200 mg/kg). C10-C20, which is a lighter weight hydrocarbon matrix, was found in soils from 8MW7 and 8MW8. Oil and grease were detected in all six groundwater samples collected during Stage 1, but Stage 2 groundwater samples were not analyzed for these compounds. Concentrations ranged from 0.5 to 1.6 mg/L.

Lead was the only metal analyzed for in soil samples collected from this combined site during Stage 1. It was detected in all soil samples collected from the FDTA, ranging from 5.59 to 25.11 mg/kg. Soil samples collected at JRHWP or during Stage 2 at FDTA were not analyzed for this parameter. Stage 2 investigations did include analysis of a fairly complete suite of metals in groundwater (Tables 4-11 and 4-13). These data were compared to background levels from the AF Plant 85 perimeter wells with the results discussed in Section 4.1.2.3.

4.1.2.2 Sampling or Analytical Problems

Two equipment blanks were collected during the groundwater sampling. Concentrations of TCE were detected in these samples. TCE was also detected in the ambient condition blank for the site. This suggests that the water used to generate the equipment blanks and the ambient condition blanks was contaminated with TCE. The amounts detected ranged between 0.6 and 1.6 µg/L. TCE was not detected in the groundwater at any of the wells sampled, but was detected in soil samples. The high TCE value (189 mg/kg) may be suspect since the concentration detected in the duplicate sample taken from this same depth was only 1.3 mg/kg; however, the original sample was confirmed in the second column but the duplicate was not. The relative percent difference between the original TCE concentration for S0403 and its duplicate is 200. This is likely due to the lack of soil sample homogenizing.

One duplicate groundwater sample was taken at monitoring well PG402. With the exception of iron, manganese, and molybdenum, the various concentrations detected in the duplicate sample were within the 25% of those of the original groundwater sample. Although iron, manganese, and molybdenum each had a RPD exceeding 25%, the concentrations for the original sample did not exceed the method detection limit by a factor of 10 (i.e., they are below the Practical Quantitation Limit or PQL). A concentration this close to the method detection limit tends to be less precise, due to the difficulty of distinguishing the small peaks on the chromatograph.

Three duplicate soil samples were submitted. These samples were collected during the installation of monitoring wells 8MW5, 8MW6, and 8MW7. No compounds were detected in any of these samples (Table 4-8).

4.1.2.3 Significance of Findings

In determining the significance of contaminants found at Combined Site 4/8, chemical concentrations will be compared with the current and proposed federal primary maximum contaminant levels (MCLs), where established for parameters in groundwater. The state of Ohio adopted the federal MCLs as state standards in May 1989. As no federal MCLs exist for contaminants in soils, guidelines from the literature will be used for comparison. The primary source used for this comparison is the state of California's designated levels, which were developed for analytes in soils at a hypothetical "average" site. These levels were developed by the California Regional Water Quality Control Board to show the use of this methodology in generating contaminant threshold levels in soils for the protection of groundwater and surface water resources. Since these designated levels were computer-generated using specific soil types found in California, caution should be used in comparing these to the concentrations, particularly inorganic, found in soil samples collected at AF Plant 85. These levels were established for illustrative purposes only, and they have no official status or legal significance, even in California. Where California designated levels were not provided for a particular analyte, other literature sources were consulted and the same precautions should be used in these comparisons as well.

Of the TCE concentrations found in soil samples at the FDTA, only the 189 mg/kg value exceeded the designated level of 5 mg/kg. However, this value did not exceed a soil AMEG (Ambient Multimedia Environmental Goal) of 1,000 mg/kg for TCE provided by Cleland and Kingsbury (1977). An AMEG is the approximate level of a contaminant "below which unacceptable negative effects in human populations or in natural biological communities should not occur with continuous exposure" (Fitchko, 1989).

The one concentration of 1,1-DCA did not exceed the designated level (20 mg/kg) and only two of the ten 1,2-DCA concentrations were above the 1.0 mg/kg guideline for soils. The designated levels for t-1,2-DCE, toluene, and 1,1,1-TCA (16, 100, and 200 mg/kg, respectively) were not exceeded by any concentrations found in soils collected at this combined site. The primary MCL for 1,1,1-TCA (200 µg/L) was also not exceeded by concentrations found in the groundwater.

Although an MCL has not been established for the presence of Freon 113 in groundwater, California lists 1.2 mg/L as the State Action Level for this parameter, which was exceeded by the concentration detected in groundwater from well PG803.

The California designated level for the PAH compounds detected in soil collected during the installation of well 8MW8 is 0.0028 mg/kg, which was exceeded by all PAH concentrations found at this location. The exception to this was fluoranthene, which has a designated level of 42 mg/kg and a concentration of 3.1 mg/kg. In addition, the tentative Netherlands soil criteria list the concentration of 20 mg/kg (dry weight) total PAHs as the delimiting value for soil quality having potential for harmful effects on human health or the environment and requiring further investigation (Fitchko, 1989). Total PAHs for the one contaminated soil sample was 13.6 mg/kg.

No federal standard exists for the presence of oil and grease in soils. The free petroleum products which tend to stress the environment most are gasoline and diesel fuels (C4 to C12 and C10 to C23 hydrocarbons, respectively). The fuel components of major concern are benzene, toluene, xylene, and ethylbenzene (BTX&E) because: 1) they are a serious threat to human health; 2) they have the potential to move through soil and contaminate groundwater; and 3) their vapors are highly flammable and explosive. The hydrocarbons detected in the soil samples collected during the installation of monitoring well 4MW4 were considerably heavier (C25 to C35) than those in gasoline and diesel and no BTX&E were detected, indicating that the above risks would not be present.

The highest concentration of lead found in the soils at the FDTA was 25.11 mg/kg, which was not above the California designated level for lead in soils for the protection of groundwater (500 mg/kg). The 500 mg/kg value is also the upper limit for lead in normal urban soils, as listed by the Ontario Ministry of the Environment guidelines (1986). Concentrations of metals detected in Stage 2 groundwater samples were compared to current and proposed primary MCLs (where established) and to estimated background levels for groundwater computed for AF Plant 85 (Table 4-14).

Samples used to derive background levels were collected from the Plant perimeter monitoring wells, collectively referred to as the perimeter wells in the Stage 2 investigation (see Section 4.1.5 for details on this site). Mean chemical concentrations were obtained by adding the concentration values from each background sample and dividing the total by the number of samples. Since these calculations are for naturally occurring metals, their presence in groundwater is expected; therefore, values for analytes with concentrations below the detection level were computed into the mean at the detection level, rather than zero. In order to more accurately compare chemical concentrations for the various sites with estimated background levels, ranges for acceptable concentrations were established by adding two standard deviations to the mean of each parameter (Table 4-14). The value at the top end of the range is referred to as the high normal background level (HNBL). For the purposes of this report, only those metals with established primary MCLs will be discussed and compared to the HNBLs.

Aluminum, barium, cadmium, chromium, fluoride, lead, mercury, and selenium concentrations in groundwater samples collected at this combined site did not exceed their respective primary MCLs or HNBLs; this medium was not analyzed for the other regulated inorganics (cyanide and nitrate). Arsenic exceeded its HNBL in one sample by 1.3 times, but did not exceed its established primary MCL.

4.1.2.3.1 Zones of Contamination. In general, the highest concentrations of contaminants were found in soil samples collected below 7.0 feet bgs. This is particularly true for oil and grease and the volatile organics. In the

Table 4-14. Background Levels and Method Detection Limits for ICP Metals in Groundwater from AF Plant 85 Perimeter Wells

Well Number	Antimony	Barium	Cadmium	Calcium	Cobalt	Copper	Iron	Magnesium	Manganese	Molybdenum	Potassium	Sodium	Zinc	Arsenic	Lead
9MW1	<0.3	0.25	<0.02	95	<0.04	<0.02	0.04	35	0.3	<0.2	1.2	18	<0.03	0.004	0.003
9MW2	0.4	0.45	<0.02	110	<0.04	<0.02	<0.02	37	0.23	0.4	2.1	13	<0.03	0.007	<0.002
9MW2-dup	0.5	0.43	<0.04	110	<0.04	<0.03	0.03	37	0.23	<0.2	1.9	16	<0.03	0.006	<0.002
9MW3	<0.3	0.31	<0.02	140	<0.04	<0.02	0.12	50	0.5	<0.2	4.8	27	<0.08	0.008	<0.002
9MW4	<0.3	0.61	<0.02	130	<0.04	<0.02	<0.02	57	0.26	<0.2	5.4	28	<0.03	0.007	<0.002
9MW5	<0.3	0.47	<0.02	110	<0.04	0.21	0.23	45	0.2	0.5	3.4	15	0.17	<0.002	0.012
9MW6	<0.3	0.15	<0.02	99	<0.04	<0.02	0.03	34	0.43	0.3	2.3	20	0.07	<0.002	<0.002
9MW7	<0.3	0.34	<0.02	130	<0.05	<0.02	1.2	56	0.1	0.2	8.1	43	0.05	0.006	<0.002
PG201	<0.3	0.20	<0.02	110	<0.05	<0.02	0.07	46	0.1	0.3	3.0	17	<0.03	<0.002	<0.002
Background Mean:	0.3	0.36	<0.02	115	0.04	0.04	0.20	44	0.37	0.28	3.6	22	0.06	0.005	0.003
Mean + 2σ:	0.5	0.65	<0.02	145	0.05	0.17	0.96	62	0.97	0.84	8.0	41	0.15	0.010	0.010
MDL:	0.3	0.004	<0.02	0.01	0.04	0.02	0.02	0.01	0.005	0.2	0.6	0.1	0.03	0.002	0.002

* These values are presented in the text as high normal background levels ($\bar{x}+2\sigma$).

MDL = Method detection limits.

Note: Beryllium, nickel, silver, and mercury values did not exceed their method detection limits and have not been included here.

FDTA this could be explained in two ways. First of all, the fire training activities would likely burn off the contaminants nearer to the surface and, secondly, any highly volatile organics at the surface on either site would have volatilized soon after being deposited. The one exception to the deeper zone of contamination occurs with lead, which has its highest concentration found between 2.5 and 4.0 feet bgs. This could be attributed to the use of leaded fuels at the FDTA, where the lead would accumulate at the shallower depth after the petroleum products are burned off and slowly leach deeper into the soils.

4.1.2.3.2 Contaminant Migration. The possible migration pathway of the organic compounds detected in the soil would be through the groundwater. However, the hydraulic conductivity in the till is estimated to be between 10^{-6} and 10^{-8} cm/sec. According to the EPA Hazardous Ranking System, the hydraulic conductivity range for various materials is $>10^{-3}$ to $<10^{-7}$ cm/sec. This would suggest that the compounds found at this site would not be transmitted through the groundwater readily.

4.1.2.3.3 Baseline Risk Assessment. Although no federal or state regulatory standards exist for the above compounds in soil and none of the contaminants found in groundwater exceeded primary MCLs, a baseline risk assessment was performed on the PAHs, TCE, and Freon 113 due to the relatively high concentrations found at this combined site. Because of the depth at which the compounds were detected, the only readily available pathway for contaminant migration would be through the groundwater. The groundwater at FDTA is monitored downgradient by well PG401; while groundwater at JRHWP is monitored by wells 8MW5 and 8MW4.

Waste characterization. The organic chemicals found in the sediments are classified as polynuclear or polycyclic aromatic hydrocarbons (PAHs), which are a class of compounds consisting of substituted and unsubstituted polycyclic aromatic rings formed by incomplete combustion of organic materials. They are derived from the distillation of coal tar and are also found in the heavier petroleum and coal tar products, such as oil and asphalt (Sax and Lewis, 1987; R. Miller, pers. com., 1989).

Data gathered on this group of chemicals have been largely inferred from research conducted on benzo(a)pyrene, which will be used here as the representative compound. The physical, chemical, and fate data for the compound are presented on Table 4-3.

The K_{oc} for this compound is 5,500,000 ml/g, indicating a very high affinity for soil or sediment. The K_{ow} for benzo(a)pyrene is 6.06, which is relatively high and indicates that the PAHs would strongly adsorb to suspended particulate matter, especially those high in organic matter (Clement Associates, 1985). The water solubility for this PAH is 1.20×10^{-3} mg/L, indicating that benzo(a)pyrene is not very soluble in water.

The toxicity data for benzo(a)pyrene are given in Table 4-5. The carcinogenic potency factor is $11.5 \text{ mg/kg/day}^{-1}$ using the oral route (SPHEM, 1986). At a cancer risk level of 10^{-4} , the acceptable benzo(a)pyrene dose for short-term exposure (i.e., during a one-month remediation effort) for a 70 kg person is 0.50 mg/day; for a 10^{-6} cancer risk, the short-term dose is 0.005 mg/day (AGWSE, 1989).

Of the PAHs found at Site 8, those with sufficient evidence to be classified as carcinogenic in animals include: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene. Chrysene has limited evidence of carcinogenicity. Data are inadequate to assess whether benzo(g,h,i)perylene and phenanthrene are carcinogenic. The available data provide no evidence that fluoranthene and pyrene are carcinogenic. Those chemicals which have been found to be carcinogenic have also been found to be mutagenic (Clement Associates, 1985). The EPA weight-of-evidence category for benzo(a)pyrene is Group B2, a probable carcinogen, indicating that there is sufficient evidence of carcinogenicity in animals, but inadequate evidence in humans.

TCE exhibits a water solubility of 1.10×10^3 mg/L (Table 4-3), indicating that it could leach into groundwater fairly readily. Solubilities range from less than 1 ppb to greater than 100,000 ppm, with most common organics

falling between 1 and 100,000 ppm (Lyman, 1982). The vapor pressure of 57.9 mm Hg suggests TCE is highly volatile, which would be a concern for high concentrations in surface soils. With a log K_{ow} of 2.38 and a Fish BCF of 10.6 l/kg, this contaminant also moderately adsorbs to organics and can bioaccumulate to some degree (Clement Associates, 1985).

TCE has been shown to be carcinogenic in long-term, high dosage laboratory tests on animals, affecting the kidneys, liver, nervous system, and skin. It was found to be mutagenic in several microbial assay systems. TCE has a low acute toxicity and the median lethal dose (LD_{50}) in several species ranged from 6,000 to 7,000 mg/kg. Three freshwater species had a LD_{50} of about 50 mg/L. No information was found on the effects of TCE on marine life, domestic animals, or terrestrial wildlife (Clement Associates, 1985). For humans, the 10^{-6} cancer risk associated with lifetime exposure to TCE in drinking water is estimated to be 2.7 μ g/L.

The physical, chemical, and fate data for Freon 113 are tabulated on Table 4-3. This compound is quite volatile (2.7×10^2 mm Hg) and is slightly soluble in water (1.0 mg/L). The log K_{ow} is 2.00, which indicates a moderate potential for sorption to organic materials.

There are very few data available concerning the risks of Freon 113. However, human exposure to vapor concentrations of 4,500 ppm or more can affect the nervous system. Freon 113 had a mild dermal effect on rabbits at a concentration of 500 mg/L and the LD_{50} due to ingestion in rats was 43 gm/kg. The compound is noncarcinogenic with an acceptable oral route intake in chronic situations of 30 mg/kg/day (Table 4-5; SPHEM, 1986). This would allow a 70 kg person to ingest 2,100 mg/day, or 356 liters per day of freon-contaminated water. (70 kg is the average weight of an individual drinking an average of 2 liters of water per day; SPHEM, 1986).

Source and release characterization. The organic compounds, as well as the lead, found at the FDTA are likely the result of past fire training activities. The toluene, methylene chloride, TCE, 1,1,1-TCA, 1,1-DCA, 1,2-DCA,

t-1,2-DCE, and petroleum products found at JRHWP are probably the result of the spills and leaks which have occurred at the storage pad. The TCE, 1,1,1-TCA, 1,1-DCA, 1,2-DCA, and t-1,2-DCE are used as solvents and mixed solvents were reported to have been stored at this site. In addition, TCE was likely mixed with the waste oils burned during fire training exercises and could exist in an isolated pocket, missed during excavation of the inactive fire pit.

Although the source of the PAHs has not been positively identified, the Stage 2 field team thought that the sample containing the PAHs may have been obtained when drilling through an old roadbed. The PAHs detected at JRHWP are byproducts of the coal tar distillation process and are also found in some of the heavier petroleum products.

There is no documentation of Freon 113 having been stored at the JRHWP or of a spill having occurred, but the waste pad does appear to be the most likely source. Freon 113 is used as a solvent and solvents were stored at this pad.

Transport media and fate of contamination. A high TCE value (189 mg/kg) was detected during Stage 1 in only soil sample (S0403) collected in the FDTA. The FDTA was deactivated in 1977, after which the site was excavated to a depth of 30 inches bgs and backfilled. Any TCE remaining at this site is likely to be contained in an isolated pocket, missed during excavation. The soils here are very low in permeability, as evidenced by the fact that no TCE, which is highly soluble in water, has reached any of the downgradient monitoring wells after 13 years of burial. However, because of the depth at which the high TCE concentration was detected (7.5 to 9.0 feet bgs), future excavation of this soil for perhaps a building foundation could stir up the TCE, allowing it to enter the atmospheric pathway.

PAHs were only found in the soils at JRHWP, indicating they are not presently being transported into the groundwater. These organic compounds could reach groundwater by leaching from polluted soils; however, these chemicals are only slightly soluble in water (1.20×10^{-3} mg/L) and adsorb readily to particulate matter. Therefore, groundwater would not be a likely

transport medium for PAHs. Atmospheric transport is possible either through adsorption to airborne particulates or by volatilization of those PAHs with low molecular weights. The PAHs were found in one soil sample at a depth of between 4.0 to 5.5 bgs and would only enter the atmosphere if these soils were disturbed.

PAHs can be bioaccumulated but are found to metabolize quickly and then be eliminated. Bioaccumulation and biodegradation are probably the ultimate fate processes for PAHs. The available data suggest that the PAHs with high molecular weights are degraded slowly by microbes and readily metabolized by multicellular organisms. Microbes appear to degrade PAHs much more completely than mammals. (Clement Associates, 1985.)

Freon 113 was found in well PG803, which was screened in the transition zone between the till and the outwash deposits. This compound was not detected in either the other downgradient wells screened in the till or in any of the wells in the vicinity screened in the deeper outwash. It appears that Freon 113 is not migrating to other groundwater monitoring wells. This compound was not detected in any of the soil samples collected at Sites 4 and 8. Since Freon 113 is quite volatile, it is possible that concentrations in soil close to the ground surface could have volatilized and entered the atmospheric medium and were transported downwind to the community of Gahanna. No fate information was found for Freon 113.

Receptors, exposure points, and exposure routes. The three exposure routes of ingestion, inhalation, and dermal contact are possible at these sites. Inhalation and dermal contact could take place if any future activities at this combined site occurred which disturbed the soils, such as during any new construction. The receptors would be those working at the site during such activities, as well as the downwind community of Gahanna. The compounds found in the soil do not occur in the groundwater, therefore ingestion is only a concern for Freon 113. The compound was detected in a transitional water-bearing zone. However, this zone is not used as a water supply, primarily due to the low yield of the water-bearing formation. Consequently, there are no

present receptors nor are there likely to be in the future unless the soils are disturbed at the FDTA.

No present threat to human health and wildlife. There does not appear to be a threat to human health or the environment by the presence of PAHs in the one soil sample collected at JRHWP. These contaminants are of limited areal extent and total PAH concentration did not exceed the tentative Netherlands guidelines which would warrant further investigation of these compounds in soils. They were not detected in groundwater samples collected from monitoring wells at this combined site. Also, since these contaminants are not very soluble in water and they are highly adsorbent to soil, the likelihood of them entering the groundwater to be consumed is low, especially considering the low yield of the water-bearing formation. Finally, the depth at which the PAHs were found is such that the only risk to health would occur if they were excavated.

Freon 113 was found in only one groundwater sample at a concentration of 5.9 mg/L. It was not detected in any of the soil samples. This compound is noncarcinogenic with an acceptable oral route intake in chronic situations of 3.00 mg/kg/day; which would allow an average person to ingest 2,100 mg/day. However, Freon 113 was detected in a transitional water-bearing zone, which is not used as a water supply due to its low yield. Therefore, it is not likely that the Freon 113 found at this site will be a threat to human health and the environment.

TCE and the other solvents were detected in relatively low concentrations, none exceeding established standards or guidelines. The one exception to this is the 189 mg/kg concentration found in one soil sample. As previously mentioned, this value may be suspect due to the low concentration found in its duplicate. However, assuming that this high value is valid, examination of the health risk from this compound is continued. TCE has a high water solubility, yet it was not detected in the groundwater samples collected from the down-gradient well monitoring the borehole in which it was found. Also, TCE is highly volatile and because of the depth at which this compound is found, the only potential risk to health from TCE would occur during excavation at this

site. Therefore, it appears that no receptors for this compound exist at this time and there is no present risk to human health and the environment. However, this may not be the case should the property containing the FDTA be sold. Because of the depth at which the high TCE concentration was detected (7.5 to 9.0 feet bgs), excavation of this soil for a building foundation could stir up the TCE, allowing it to enter the atmospheric pathway. A deed disclosure, describing the possibility of TCE on the site, might be required before the Air Force could sell it.

4.1.3 Discussion of Results for Mason's Run (Site 5)

Mason's Run is located in the central area of the Plant. It enters the Plant boundaries from the Port Columbus Airport, flows south through the facility, and exits near the entrance to AF Plant 85 on Fifth Avenue. Mason's Run is channeled with a concrete culvert through most of its extent within the Plant boundaries. Figure 1-2 shows the location and path of the stream through the Plant, while Figures 4-7 and 4-8 give details of the northern and southern extent of Mason's Run.

Since 1941, Mason's Run has received miscellaneous spills of oil and fuel, usually as a result of surface water runoff entering the extensive on-site stormwater drainage system which empties into the run. Surface drainage enters the storm drains during periods of heavy precipitation; the system is connected to Mason's Run in the central portion of the facility and to Turkey Run towards the west. An oil skimmer system with a floating boom and concrete weir were installed about 15 years ago on Mason's Run where it exits the facility near Fifth Avenue. This system lies outside of the perimeter fence but is still on Plant property. In addition to the various oil and fuel spills, approximately 50,000 gallons of coal pile leachate entered Mason's Run when a holding tank leaked in May 1983. Also, several fish kills have been reported on Mason's Run downstream of the Plant. During the RI/FS, Stage 2 investigation (September and December 1988), an oil sheen was visible on Mason's Run near its exit point on Fifth Avenue.

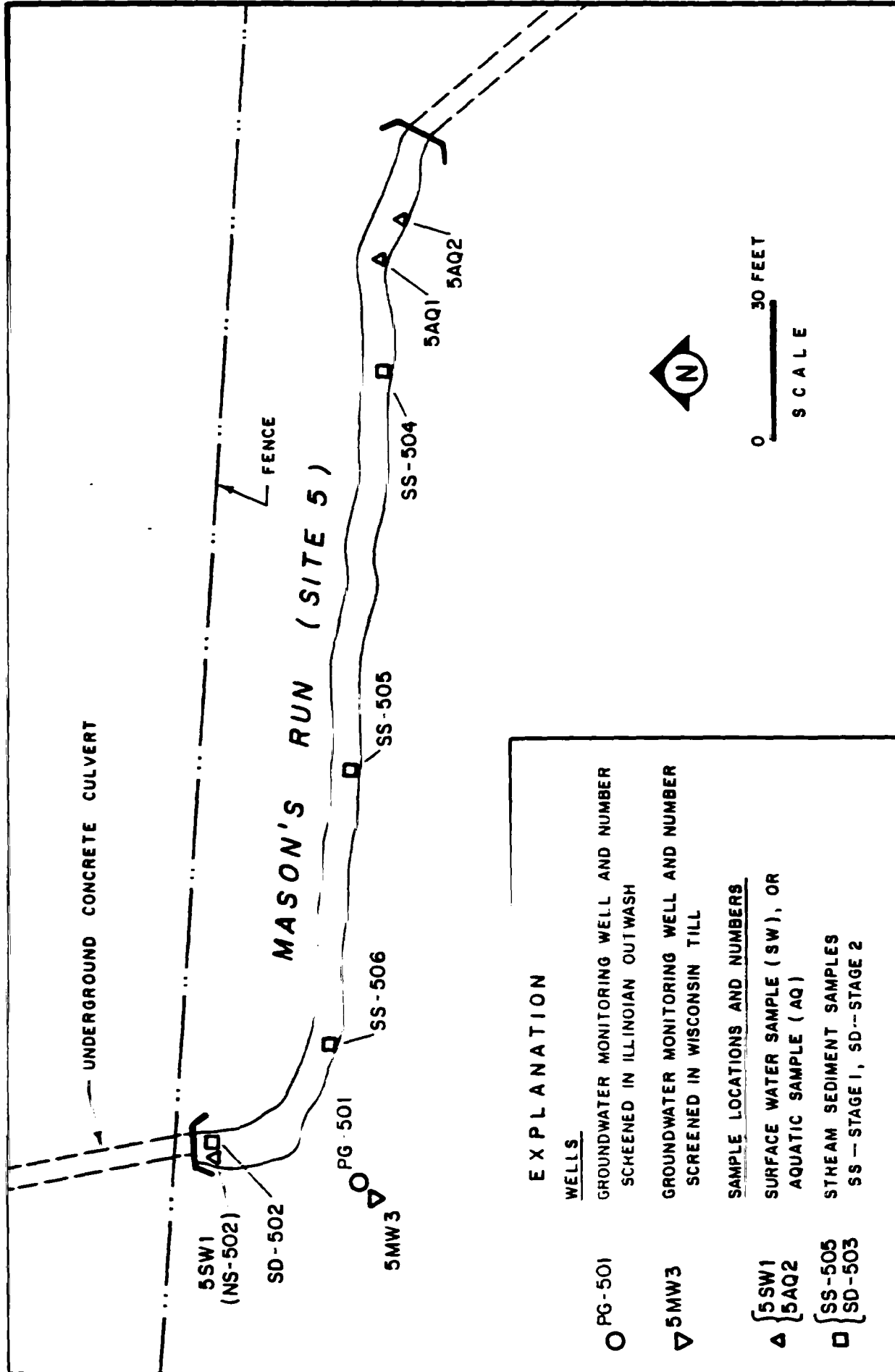


Figure 4-7. Northern extent of Mason's Run (Site 5), AF Plant 85.

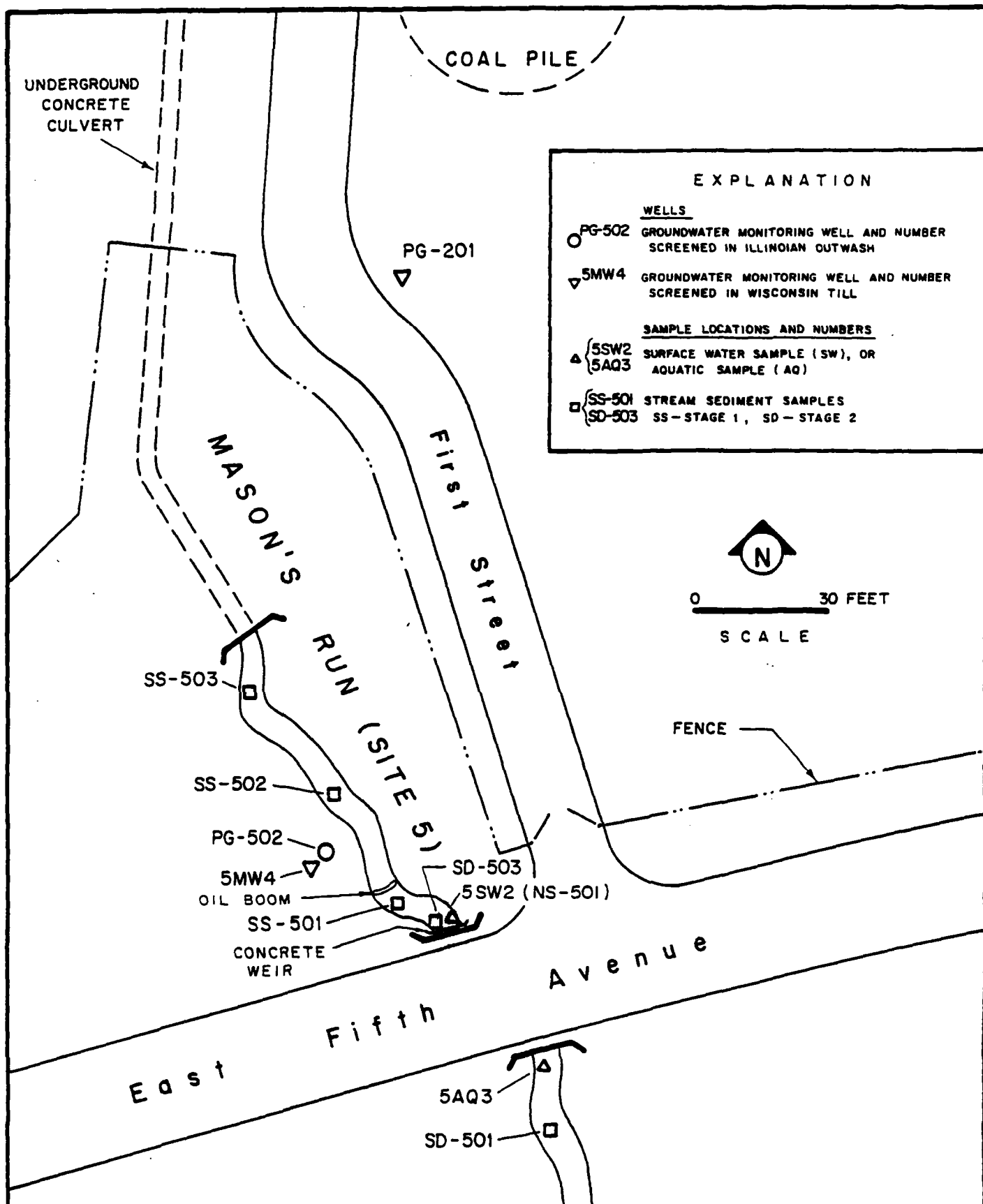


Figure 4-8. Southern extent of Mason's Run (Site 5),
AF Plant 85.

4.1.3.1 Presentation of Results

4.1.3.1.1 Site Geology/Hydrogeology. The Plant lies within the drainage basin of Big Walnut Creek which is a tributary of the Scioto River. The general direction of surface water drainage at the Plant is shown on Figure 2-8. Mason's Run flows southward and eventually joins Big Walnut Creek approximately 5 miles south of the Plant. Flow within the run is generally low except during times of heavy precipitation. A large portion of the facility is paved, so surface runoff depends on recent precipitation or snowmelt. On-site soils are relatively impermeable (4×10^{-5} to 1×10^{-4}), which adds to the amount of surface water runoff entering Mason's Run.

Two monitoring wells (5MW3 and 5MW4) were installed along Mason's Run during the Stage 2 field program. Well 5MW3 is located where Mason's Run enters AF Plant 85 and well 5MW4 is located on the southern portion of the Plant where the stream exits the facility.

Two wells (PG501 and PG502) were previously installed during the earlier IRP Phase II, Stage 1 investigation; PG502 was screened in the outwash, PG501 in an interbedded zone. A pair of wells are now in place where Mason's Run enters the facility and a pair are located where the stream exits Plant 85 near Fifth Avenue. Each of the paired wells has been drilled and developed in separate water-bearing zones. Wells 5MW3 and 5MW4 are screened in the shallow Wisconsin glacial till, which is essentially a heterogeneous mixture of boulders, cobbles, gravels, sands, and clays. The borehole for well 5MW4 showed a mixture of sand, silt, clay, and cobbles of shale and limestone. The clay was gray to dark gray in color and ranged from a sandy to silty clay. The borehole for well 5MW3 consists of the same gray to grayish-brown sandy and silty clay.

The outwash, which was formed by meltwaters draining from the glacial ice, forms somewhat well-sorted deposits of sand and gravel. The soil borings for these wells PG501 and PG502 show gravel and shale fragments from 35 to 50 feet (see lithologic logs, Appendix C). This deeper outwash formation is separated

from the shallower till by several feet of dry grayish-brown clay. Soil borings for wells PG501 and 5MW3 give a good description of this confining layer (Appendix C).

4.1.3.1.2 Analytical Results. Two soil samples were taken from PG501 and PG502 and submitted for analysis during Stage 1 only. The results of the soil sampling are found on Table 4-15.

Data from six groundwater samples are presented in Tables 4-16 and 4-17. Wells PG501 and PG502 were sampled during both Stages 1 and 2. Wells 5MW3 and 5MW4 were sampled during Stage 2. Wells PG501 and PG502 primarily monitor the outwash, while wells 5MW3 and 5MW4 primarily monitor the till.

During Stage 1, surface water samples were taken at three different times in one day: prior to the beginning of the work day, at the noon hour, and at the end of the day shift, providing data on how facility activities affect Mason's Run. Stage 2 sampling consisted of retrieving two surface water samples, one upstream and one downstream. The results of the surface water sampling are found on Tables 4-18 and 4-19.

Seven sediment samples were collected during the Stage 1 investigation and three samples during the Stage 2 investigation. Tables 4-20 and 4-21 show the concentrations of the compounds and elements detected.

4.1.3.1.3 Discussion of Analytical Data. Both organic and inorganic constituents were detected in soil, sediment, groundwater, and surface water samples collected from Mason's Run.

The most prevalent organic compounds found at this site were oil and grease and other related petroleum products, including PAHs. Oil and grease were detected in Stage 1 soil samples collected during the installation of monitoring wells PG501 and PG502. Concentrations ranged from 93.3 to 518 mg/kg at depths from 15.0 to 51.5 feet bgs. Groundwater samples collected from these same wells showed oil and grease concentrations of 1.4 and 1.1 mg/L, respectively. Surface

TABLE 4-15

ANALYTICAL DATA FOR SOIL SAMPLES COLLECTED AT WAGON'S RUN (SITE 6)
DURING PHASE II, STAGE 1, AF PLANT 85

Parameter	Method	Units	Method Detection Limits	Standards and Action Levels ----- Federal State	Site			
					Station Depth	PG 501 15.0 - 10.5	PG 501 25.0 - 20.5	PG 502 40.0 - 41.5
					Sample Type Date Coll.	12/13/85 03-85-5001	12/13/85 03-85-5002	01/09/86 03-85-5003
					Field No.	FG-222	FG-223	FG-507
					Lab No.			FG-508
Cadmium	SV 7100	ug/kg	0.2			0.24	0.51	0.22
Chromium	SV 7210	ug/kg	0.0001			4.54	4.10	4.05
Lead	SV 7420	ug/kg	0.000			7.30	11.30	8.00
Nickel	SV 7320	ug/kg	0.002			24.2	10.1	20.1
Oil and Grease	E 413.2	ug/kg	NA			154	201	93.3
1,1-Dichloroethane	SV 8010	ug/kg	0.0044			---	---	---
1,2-Dichloroethane	SV 8010	ug/kg	0.0044			---	---	---
Methylene chloride	SV 8010	ug/kg	0.0044			---	---	---
Tetrachloroethylene	SV 8010	ug/kg	0.0044			---	---	---
Trans-1,2-Dichloroethylene	SV 8010	ug/kg	0.0044			---	---	---
1,1,1-Trichloroethane	SV 8010	ug/kg	0.0044			---	---	---
Trichloroethylene	SV 8010	ug/kg	0.0040			---	---	---
Toluene	SV 8020	ug/kg	0.0034			---	---	---
Aroclor 1200	SV 8000	ug/kg	NA			---	---	---
Moisture in soil		Percent				0.20	10.00	11.77
								70.46

0 = Where no values are given, parameter is not regulated.

NA = Not available.

ND = Not detected.

--- = Sample not analyzed for this parameter.

TABLE 4-16

ANALYTICAL DATA FOR GROUNDWATER SAMPLES COLLECTED AT MASON'S RUN (SITE 6)
DURING PHASE II, STAGE 1, AF PLANT 05

Parameter	Method	Units	Method Detection Limits	Standards and Action Levels(a)		Site				
				Federal	State	Station Sample Type Date Coll.	PG 501	PG 502	PG 502 Dup 5012 3/5/86	PG 502 3/5/86 GP-86-5013 FJ-491
*Total Dissolved Solids	E 100.1	mg/L	1	500.0	500.0	---	404	1102	---	---
*Sulfate	E 300	mg/L	0.0005	250.0	250.0	3/5/86	73.0	556	---	---
Arsenic	E 200.2	mg/L	0.0034	0.05	0.05	---	---	---	---	0.0055
Cadmium, Total	E 213.2	mg/L	0.0001	0.01 (0.005)	0.01	3/5/86	---	---	---	---
Cadmium, Dissolved	E 213.2	mg/L	0.0001	0.01 (0.005)	0.01	3/5/86	---	---	---	---
Chromium, Total	E 218.2	mg/L	0.001	0.01 (0.005)	0.01	3/5/86	---	---	---	---
Chromium, Dissolved	E 218.2	mg/L	0.001	0.01 (0.005)	0.01	3/5/86	---	---	---	---
*Copper	E 220.2	mg/L	0.0012	1.0	1.0	---	---	---	---	---
Lead, Total	E 239.2	mg/L	0.0006	0.05 (0.005)	0.05	3/5/86	---	---	---	---
Lead, Dissolved	E 239.2	mg/L	0.0006	0.05 (0.005)	0.05	3/5/86	---	---	---	---
*Manganese	E 243.2	mg/L	0.0003	0.05	0.05	---	---	---	---	---
Nickel, Total	E 249.2	mg/L	0.001	0.05	0.05	---	---	---	---	---
Nickel, Dissolved	E 249.2	mg/L	0.001	0.05	0.05	---	---	---	---	---
*Zinc	E 289.1	mg/L	0.002	5.0	5.0	---	---	---	---	---
Total Organic Carbon	E 415.1	mg/L	0.005	---	---	---	0.2	1.7	---	---
Total Organic Halides	SW 9020	ug/L	10	---	---	---	ND	ND	---	---
Oil and Grease	E 413.2	mg/l	0.1	---	---	---	1.4	1.1	1.3	---
1,1,1-Trichloroethane	E 601	ug/L	1	200.0	200.0	---	ND	ND	---	---
Chloroform	E 601	ug/L	1	100.0 + 100.0 *	---	---	ND	ND	---	---
Aromatic VOCs	E 602	ug/L	1	---	---	---	ND	ND	---	---

* = Parameters with secondary maximum contaminant levels for standards.

(a) = Where no values are given, parameter is not regulated.

ND = Not detected.

= Sample not analyzed for this parameter.

= Standards listed in parentheses are proposed Federal MCLs with the final rule expected in 1995.

* = For total trihaloethanes group.

TABLE 4-17

ANALYTICAL DATA FOR GROUNDWATER SAMPLES COLLECTED AT MASON'S RUN (SITE 5)
DURING RI/FS, STAGE 2, AF PLANT 05

Parameter	Method	Units	Method Detection Limits	Standards and Action Levels (a) Federal State	Site Station Sample Type Date Coll.	Site			
						PG 501	PG 502	PG 502	PG 503
•Total Dissolved Solids	E100.1	mg/L	10	500.0 500.0	11/22/00	11/22/00	11/22/00	11/22/00	11/22/00
•Chloride	E300	mg/L	0.5	250.0 250.0	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
•Fluoride	E300	mg/L	0.5	4.0 4.0	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
•Sulfate	E300	mg/L	1.0	250.0 250.0	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Antimony	SW 0010	mg/L	0.3		095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Barium	SW 0010	mg/L	0.004	5.0 1.0	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Beryllium	SW 0010	mg/L	0.001		095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Cadmium	SW 0010	mg/L	0.2	1.0 (0.005) 0.01	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Calcium	SW 0010	mg/L	0.01		095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Cobalt	SW 0010	mg/L	0.04		095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Copper	SW 0010	mg/L	0.02	0.01 (1.3) 1.0	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
•Iron	SW 0010	mg/L	0.02	0.3 0.3	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Magnesium	SW 0010	mg/L	0.01		095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Manganese	SW 0010	mg/L	0.005	0.05 0.05	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Molybdenum	SW 0010	mg/L	0.2		095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Nickel	SW 0010	mg/L	0.04		095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Potassium	SW 0010	mg/L	0.6		095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Silver	SW 0010	mg/L	0.02	0.05 (*) 0.05	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Sodium	SW 0010	mg/L	0.1		095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
•Zinc	SW 0010	mg/L	0.03	5.0 5.0	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Arsenic	SW 7000	mg/L	0.002	0.05 0.05	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Lead	SW 7421	mg/L	0.002	0.05 (0.005) 0.05	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Mercury	SW 7470	mg/L	0.00006	0.002 0.002	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
1,1,1-Trichloroethane	SW 0010	ug/L	0.5	200.0 200.0	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Bromodichloroethane	SW 0010	ug/L	0.5	100.0 * 100.0 *	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Chloroform	SW 0010	ug/L	0.2	100.0 * 100.0 *	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Dibromochloroethane	SW 0010	ug/L	0.5	100.0 * 100.0 *	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Freon 113	SW 0010	ug/L	0.5		095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Methylene chloride	SW 0010	ug/L	2.0		095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Trichloroethylene	SW 0010	ug/L	0.5	5.0 5.0	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Toluene	SW 0020	ug/L	0.5	(2000.0)	095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003
Semivolatile Organics	SW 0270	ug/L			095-CW-005-001	095-CW-005-005	095-CW-005-002	095-CW-005-003	095-CW-005-003

* = Parameters with secondary maximum contaminant levels for standards.

(a) = Where no values are given, parameter is not regulated.

ND = Not detected.

= Sample not analyzed for this parameter.

= Standards listed in parentheses are proposed Federal MCLs with the final rule expected in 1990.

= For total trihalomethanes group.

TABLE 4-17

ANALYTICAL DATA FOR GROUNDWATER SAMPLES COLLECTED AT MASON'S RUN (SITE 5)
DURING RI/FS, STAGE 2, AF PLANT 85
(Continued)

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels(a)		Site			
				Federal	State	Station Sample Type Date Coll. Field No. Lab No.	SMW3 AC Blank 11/22/88 985-GW-885-884 8811369+3	SMW4 -- 12/07/88 985-GW-885-886 8812152+5	Bldg 124 1st Column 12/12/88 985-PW-885-913 8812288+1
•Total Dissolved Solids	E160.1	mg/L	10	500.0	500.0			2500	140
•Chloride	E300	mg/L	0.5	250.0	250.0			37	17
•Fluoride	E300	mg/L	0.5	4.0	4.0			ND	0.8
•Sulfate	E300	mg/L	1.0	250.0	250.0			110	41
Antimony	SW 8010	mg/L	0.3					0.3	ND
Barium	SW 8010	mg/L	0.004	5.0	1.0			0.042	0.022
Beryllium	SW 8010	mg/L	0.001					ND	0.003
Cadmium	SW 8010	mg/L	0.2	1.0 (0.005)	0.01			ND	ND
Calcium	SW 8010	mg/L	0.01					400	21
Cobalt	SW 8010	mg/L	0.04					ND	ND
Copper	SW 8010	mg/L	0.02	0.01(1.3)	1.0			ND	ND
•Iron	SW 8010	mg/L	0.02	0.3	0.3			ND	0.06
Magnesium	SW 8010	mg/L	0.01					100	0.0
•Manganese	SW 8010	mg/L	0.005	0.05	0.05			0.02	0.017
Molybdenum	SW 8010	mg/L	0.2					ND	ND
Nickel	SW 8010	mg/L	0.04					ND	ND
Potassium	SW 8010	mg/L	0.0					16	3.7
Silver	SW 8010	mg/L	0.02	0.05(+)	0.05			0.02	ND
Sodium	SW 8010	mg/L	0.1					19	12
•Zinc	SW 8010	mg/L	0.03	5.0	5.0			0.1	0.29
Arsenic	SW 7000	mg/L	0.002	0.05	0.05			ND	ND
Lead	SW 7421	mg/L	0.002	0.05(0.005)	0.05			ND	ND
Mercury	SW 7470	mg/L	0.0008	0.002	0.002			ND	0.0026
1,1,1-Trichloroethane	SW 8010	ug/L	0.5	200.0	200.0		ND	ND	ND
Bromodichloromethane	SW 8010	ug/L	0.5	100.0 + 100.0 +			ND	ND	3.7
Chloroform	SW 8010	ug/L	0.2	100.0 + 100.0 +			ND	ND	66
Dibromochloromethane	SW 8010	ug/L	0.5	100.0 + 100.0 +			ND	ND	0.6
Freon 113	SW 8010	ug/L	0.5				ND	ND	ND
Methylene chloride	SW 8010	ug/L	2.0				ND	ND	2.1
Trichloroethylene	SW 8010	ug/L	0.5	5.0	5.0		ND	ND	ND
Toluene	SW 8020	ug/L	0.5	(2000.0)			ND	ND	ND
Semivolatile Organics	SW 8270	ug/L						ND	ND

* = Parameters with secondary maximum contaminant levels for standards.

(a) = Where no values are given, parameter is not regulated.
ND = Not detected.

U = Sample not analyzed for this parameter.

† = Standards listed in parentheses are proposed Federal MCLs with the final rule expected in 1999.
+ = For total trihalomethanes group.

TABLE 4-10
ANALYTICAL DATA FOR SURFACE WATER SAMPLES COLLECTED AT MASON'S RUN (SITE 6)
DURING PHASE II, STAGE 1, AF PLANT 06

Parameter	Method	Units	Detection Limits	Standards and Action Levels(a) ----- Federal State	Site			
					Station	Sample Type	Field No.	Lab No.
					MS 501	MS 501	MS 501	MS 501
•Total Dissolved Solids	E 100.1	mg/L	1	500.0 500.0	---	---	3/8/06 OH-06-5014 FJ-492	3/8/06 OH-06-5016 FJ-494
•Sulfate	E 300	mg/L	0.0005	250.0 250.0	49.2	52.4	65.0	65.0
Arsenic	E 200.2	mg/L	0.0034	0.05 0.05	0.0003	0.0003	0.0003	0.0003
Cadmium, Total	E 213.2	mg/L	0.0001	0.01(0.005) 0.01	0.0002	ND	0.0001	0.0001
Cadmium, Dissolved	E 213.2	mg/L	0.0001	0.01(0.005) 0.01	0.0041	0.0031	0.0025	0.0025
Chromium, Total	E 218.2	mg/L	0.001		0.0039	0.0029	0.0034	0.0034
Chromium, Dissolved	E 218.2	mg/L	0.001					
Copper	E 220.2	mg/L	0.0012	1.0(1.3) 1.0	0.0174	0.0178	0.0177	0.0177
Lead, Total	E 239.2	mg/L	0.0006	0.05(0.005) 0.05	0.0055	0.0055	0.0038	0.0038
Lead, Dissolved	E 239.2	mg/L	0.0006	0.05(0.005) 0.05				
•Manganese	E 243.2	mg/L	0.0003	0.05 0.05	0.0053	0.0072	0.0025	0.0025
Nickel, Total	E 249.2	mg/L	0.001		0.0034	0.0029	0.0015	0.0015
Nickel, Dissolved	E 249.2	mg/L	0.001					
•Zinc	E 289.1	mg/L	0.002	5.0 5.0	---	---	---	---
Total Organic Carbon	E 415.1	mg/L	0.005		0.5	15.3	17.0	17.0
Total Organic Halides	SW 9020	ug/L	10		40.0	64.3	78.2	78.2
Oil and Grease	E 413.2	mg/l	0.1		1.5	1.7	1.1	1.1
1,1,1-Trichloroethane	E 001	ug/L	1	200.0 200.0	1.0	ND	ND	ND
Chloroform	E 001	ug/L	1	100.0 100.0	5.0	12.0	12.0	12.0
Aromatic VOCs	E 002	ug/L	1		ND	ND	ND	ND

• = Parameters with secondary maximum contaminant levels for standards.

(a) = Where no values are given, parameter is not regulated.

ND = Not detected.

U = Sample not analyzed for this parameter.

T = Standards listed in parentheses are proposed Federal MCLs with the final rule expected in 1999.

• = For total trihaloethanes group.

TABLE 4-18
ANALYTICAL DATA FOR SURFACE WATER SAMPLES COLLECTED AT MASON'S RUN (SITE 5)
DURING PHASE II, STAGE 1, AF PLANT 85
(Continued)

Parameter	Method	Units	Method Detection Limits	Standards and Action Levels(a)		Site		
				Federal	State	Station Sample Type Date Coll. Field No. Lab No.	NS 502	NS 502
*Total Dissolved Solids	E 100.1	mg/L	1	500.0	500.0	NS 502	NS 502	NS 502
*Sulfate	E 300	mg/L	0.0005	250.0	250.0	3/6/86 GN-86-5015 FJ-493	3/6/86 GN-86-5017 FJ-496	3/6/86 GN-86-5019 FJ-497
Arsenic	E 200.2	mg/L	0.0034	0.05	0.05			
Cadmium, Total	E 213.2	mg/L	0.0001	0.01(0.005)	0.01	0.0001	0.0001	0.0001
Cadmium, Dissolved	E 213.2	mg/L	0.0001	0.01(0.005)	0.01	0.0001	0.0001	0.0001
Chromium, Total	E 218.2	mg/L	0.001			0.0024	0.0017	0.0018
Chromium, Dissolved	E 218.2	mg/L	0.001			0.0022	0.0012	0.0018
Copper	E 220.2	mg/L	0.0012	1.0(1.3)	1.0			
Lead, Total	E 239.2	mg/L	0.0006	0.05(0.005)	0.05	0.0194	0.0136	0.0143
Lead, Dissolved	E 239.2	mg/L	0.0006	0.05(0.005)	0.05	0.0106	0.0058	0.0034
*Manganese	E 243.2	mg/L	0.0003	0.05	0.05			
Nickel, Total	E 249.2	mg/L	0.001			0.0007	0.0053	0.0042
Nickel, Dissolved	E 249.2	mg/L	0.001			0.0058	0.0048	0.0058
*Zinc	E 200.1	mg/L	0.002	5.0	5.0			
Total Organic Carbon	E 415.1	mg/L	0.005			26.5	36.5	31.9
Total Organic Halides	SW 9020	ug/L	10			26.2	27.2	32.8
Oil and Grease	E 413.2	mg/l	0.1			2.3	1.4	1.3
1,1,1-Trichloroethane	E 601	ug/L	1	200.0	200.0	ND	ND	ND
Chloroform	E 601	ug/L	1	100.0	100.0	ND	ND	ND
Aromatic VOCs	E 602	ug/L	1			ND	ND	ND

* = Parameters with secondary maximum contaminant levels for standards.

(a) = Where no values are given, parameter is not regulated.

ND = Not detected.

U = Sample not analyzed for this parameter.

T = Standards listed in parentheses are proposed Federal MCLs with the final rule expected in 1990.

* = For total trihalomethanes group.

TABLE 4-10
ANALYTICAL DATA FOR SURFACE WATER SAMPLES COLLECTED AT MASON'S RUN (SITE 6)
DURING RI/F3, STAGE 2, AF PLANT 05

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels(a) ----- Federal State	Site			
					Station		Sample Type	
					Date Coll.		Field No.	
					65W1	65W2	65W1	65W2
•Total Dissolved Solids	E100.1	mg/L	10	500.0 500.0	---	---	---	---
•Chloride	E300	mg/L	0.5	250.0 250.0	12/09/00	3/16/00	---	1st Column
•Fluoride	E300	mg/L	0.5	4.0 4.0	005-SV-005-002	005-SV-005-004	005-SV-005-001	12/09/00
•Sulfate	E300	mg/L	1.0	250.0 250.0	0012152+4	03-324-2	0012152+3	005-SV-005-001
Antimony	SV 0010	mg/L	0.3					
Barium	SV 0010	mg/L	0.004	1.0(5.0) 1.0				
Beryllium	SV 0010	mg/L	0.001					
Cadmium	SV 0010	mg/L	0.2	0.01(0.005) 0.01				
Calcium	SV 0010	mg/L	0.01					
Cobalt	SV 0010	mg/L	0.04					
Copper	SV 0010	mg/L	0.02	1.0(1.3) 1.0				
•Iron	SV 0010	mg/L	0.02	0.3 0.3				
Magnesium	SV 0010	mg/L	0.01					
•Manganese	SV 0010	mg/L	0.005	0.05 0.05				
Molybdenum	SV 0010	mg/L	0.2					
Nickel	SV 0010	mg/L	0.04					
Potassium	SV 0010	mg/L	0.6					
Silver	SV 0010	mg/L	0.02	0.05(•) 0.05				
Sodium	SV 0010	mg/L	0.1					
•Zinc	SV 0010	mg/L	0.03	5.0 5.0				
Arsenic	SV 7000	mg/L	0.002	0.05 0.05				
Lead	SV 7421	mg/L	0.002	0.05(0.005) 0.05				
Mercury	SV 7470	mg/L	0.0000	0.002 0.002				
1,1,1-Trichloroethane	SV 0010	ug/L	0.5	200.0 200.0				
Bromodichloroethane	SV 0010	ug/L	0.5	100.0 • 100.0 •				
Chloroform	SV 0010	ug/L	0.2	100.0 • 100.0 •				
Dibromochloroethane	SV 0010	ug/L	0.5	100.0 • 100.0 •				
Freon 113	SV 0010	ug/L	0.5					
Methylene chloride	SV 0010	ug/L	2					
Trichloroethylene	SV 0010	ug/L	0.5	5.0 5.0				
Toluene	SV 0020	ug/L	0.5	(2000.0)				
Semi-volatile Organics	SV 8270							

• = Parameters with secondary maximum contaminant levels for standards.

(a) = Where no values are given, parameter is not regulated.

ND = Not detected.

• = Sample not analyzed for this parameter.

• = Standards listed in parentheses are proposed Federal MCLs with the final rule expected in 1999.

• = For total trihalomethanes group.

TABLE 4-19
ANALYTICAL DATA FOR SURFACE WATER SAMPLES COLLECTED AT MASON'S RUN (SITE 5)
DURING RI/FS, STAGE 2, AF PLANT 85
(Continued)

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels(a)	Site			
					Station		Sample Type	
					Federal	State	Date Coll.	Field No.
*Total Dissolved Solids	E168.1	mg/L	10	500.0 500.0			12/08/88	085-SW-005-001 085-SW-005-003 085-SW-005-003
*Chloride	E300	mg/L	0.5	250.0 250.0			3/15/89	085-SW-005-003 085-SW-005-003 085-SW-005-003
*Fluoride	E300	mg/L	0.5	4.0 4.0				
*Sulfate	E300	mg/L	1.0	250.0 250.0				
Antimony	SW 6010	mg/L	0.3					
Barium	SW 6010	mg/L	0.004	1.0(5.0) 1.0				
Beryllium	SW 6010	mg/L	0.001					
Cadmium	SW 6010	mg/L	0.2	0.01(0.005) 0.01				
Calcium	SW 6010	mg/L	0.01					
Cobalt	SW 6010	mg/L	0.04					
Copper	SW 6010	mg/L	0.02	1.0(1.3) 1.0				
*Iron	SW 6010	mg/L	0.02	0.3 0.3				
Magnesium	SW 6010	mg/L	0.01					
*Manganese	SW 6010	mg/L	0.005	0.05 0.05				
Molybdenum	SW 6010	mg/L	0.2					
Nickel	SW 6010	mg/L	0.04					
Potassium	SW 6010	mg/L	0.6					
Silver	SW 6010	mg/L	0.02	0.05(+) 0.05				
Sodium	SW 6010	mg/L	0.1					
*Zinc	SW 6010	mg/L	0.03	5.0 5.0				
Arsenic	SW 7000	mg/L	0.002	0.05 0.05				
Lead	SW 7421	mg/L	0.002	0.05(0.005) 0.05				
Mercury	SW 7470	mg/L	0.0008	0.002 0.002				
1,1,1-Trichloroethane	SW 8010	ug/L	0.5	200.0 200.0			1.1	0.8
Bromodichloromethane	SW 8010	ug/L	0.5	100.0 + 100.0 +			ND	ND
Chloroform	SW 8010	ug/L	0.2	100.0 + 100.0 +			1.3	0.9
Dibromochloromethane	SW 8010	ug/L	0.5	100.0 + 100.0 +			ND	ND
Freon 113	SW 8010	ug/L	0.5				ND	ND
Methylene chloride	SW 8010	ug/L	2				ND	ND
Trichloroethylene	SW 8010	ug/L	0.5	5.0 5.0			1.6	0.5
Toluene	SW 8020	ug/L	0.5	(2000.0)				
Semi-volatile Organics	SW 8270							

* = Parameters with secondary maximum contaminant levels for standards.

(a) = Where no values are given, parameter is not regulated.

ND = Not detected.

U = Sample not analyzed for this parameter.

T = Standards listed in parentheses are proposed Federal MCLs with the final rule expected in 1998.

+ = For total trihalomethanes group.

TABLE 4-20

ANALYTICAL DATA FOR SEDIMENT SAMPLES COLLECTED AT WAGON'S RUN (SITE 6)
DURING PHASE II, STAGE 1, AF PLANT 06

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels ----- Federal State	Site				
					Station	SS 501	SS 502	SS 503	SS 505
					Depth	--	--	--	--
					Sample Type Date Coll.	01/00/00 OC-00-0001 FG-000	01/00/00 OC-00-0002 FG-001	01/00/00 OC-00-0003 FG-002	01/00/00 OC-00-0007 FG-000
Cadmium	SV 7100	ng/kg	0.2			0.00	2.00	1.04	0.10
Chromium	SV 7210	ng/kg	0.0001			21.0	207	132	110
Lead	SV 7420	ng/kg	0.000			55.5	292	292	
Nickel	SV 7320	ng/kg	0.002			21.1	150	51.2	
Oil and Grease	E 413.2	ng/kg	NA			2012	7325	1700	
1,1-Dichloroethane	SV 0010	ng/kg	0.0044						
1,2-Dichloroethane	SV 0010	ng/kg	0.0044						
Methylene chloride	SV 0010	ng/kg	0.0044						
Tetrachloroethylene	SV 0010	ng/kg	0.0044						
Trans-1,2-Dichloroethylene	SV 0010	ng/kg	0.0044						
1,1,1-Trichloroethane	SV 0010	ng/kg	0.0044						
Trichloroethylene	SV 0010	ng/kg	0.0040						
Toluene	SV 0020	ng/kg	0.0034						
Aroclor 1200	SV 0000	ng/kg	NA						
Moisture in soil		Percent				21.05	84.71	52.04	60.74

0 = Where no values are given, parameter is not regulated.

NA = Not available.

ND = Not detected.

— = Sample not analyzed for this parameter.

TABLE 4-26
ANALYTICAL DATA FOR SEDIMENT SAMPLES COLLECTED AT MASON'S RUN (SITE 5)
DURING PHASE II, STAGE 1, AF PLANT 86
(Continued)

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels ----- Federal State	Site			
					Station	Depth	Sample Type	Lab No.
					SS 504	SS 505	Date Coll.	Field No.
Cadmium	SW 7130	ug/kg	0.2		0.73	2.07	01/07/86	01/07/86
Chromium	SW 7210	ug/kg	0.0001		7.3	17.2	01/07/86	01/07/86
Lead	SW 7420	ug/kg	0.000		29.4	94.2	01/07/86	01/07/86
Nickel	SW 7320	ug/kg	0.002		10.1	57.4	01/07/86	01/07/86
Oil and Grease	E 413.2	ug/kg	NA		72.9	454	01/07/86	01/07/86
1,1-Dichloroethane	SW 8010	ug/kg	0.0044				01/07/86	01/07/86
1,2-Dichloroethane	SW 8010	ug/kg	0.0044				01/07/86	01/07/86
Methylene chloride	SW 8010	ug/kg	0.0044				01/07/86	01/07/86
Tetrachloroethylene	SW 8010	ug/kg	0.0044				01/07/86	01/07/86
Trans-1,2-Dichloroethylene	SW 8010	ug/kg	0.0044				01/07/86	01/07/86
1,1,1-Trichloroethane	SW 8010	ug/kg	0.0044				01/07/86	01/07/86
Trichloroethylene	SW 8010	ug/kg	0.0049				01/07/86	01/07/86
Toluene	SW 8020	ug/kg	0.0034				01/07/86	01/07/86
Aroclor 1260	SW 8080	ug/kg	NA				01/07/86	01/07/86
Moisture in soil		Percent			67.25	85.93	01/07/86	01/07/86

0 = Where no values are given, parameter is not regulated.

NA = Not available.

ND = Not detected.

— = Sample not analyzed for this parameter.

TABLE 4-21

ANALYTICAL DATA FOR SEDIMENT SAMPLES COLLECTED AT MASON'S RUN (SITE 5)
DURING RI/FS, STAGE 2, AF PLANT 85

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels ----- Federal State	Site Station	5	5	5
					Depth	SD502	SD503	SD501
					Sample Type	0.0-0.5	0.0-0.5	0.0-0.5
					Date Coll.	12/08/88	12/12/88	12/08/88
					Field No.	005-SD-005-002	005-SD-005-003	005-SD-005-001
					Lab No.	0012150+4	0012209+1	0012156+3
Silver	SW 0010	ng/kg	0.5			2	2.6	1.9
Aluminum	SW 0010	ng/kg	5			9000	3000	8000
Barium	SW 0010	ng/kg	0.1			90	51	240
Beryllium	SW 0010	ng/kg	0.00			0.3	0.05	0.30
Calcium	SW 0010	ng/kg	0.3			60000	150000	40000
Cadmium	SW 0010	ng/kg	0.5			ND	13	4
Cobalt	SW 0010	ng/kg	1			4	1	8
Chromium	SW 0010	ng/kg	1			10	40	40
Copper	SW 0010	ng/kg	0.5			45	35	31
Iron	SW 0010	ng/kg	0.5			21000	6000	30000
Potassium	SW 0010	ng/kg	20			1000	150	970
Magnesium	SW 0010	ng/kg	0.3			17000	34000	18000
Manganese	SW 0010	ng/kg	0.1			470	200	450
Sodium	SW 0010	ng/kg	3			130	100	77
Nickel	SW 0010	ng/kg	1			25	4	30
Vanadium	SW 0010	ng/kg	0.0			23	55	22
Zinc	SW 0010	ng/kg	0.0			400	400	100
Mercury	SW 7471	ng/kg	0.4			ND	0.5	ND
Acenaphthene	SW 0270	ng/kg	0.5			ND	920	1.5
Anthracene	SW 0270	ng/kg	0.5			ND	130	ND
Benzo(a)anthracene	SW 0270	ng/kg	0.5			ND	290	6.4
Benzo(a)pyrene	SW 0270	ng/kg	0.5			ND	260	7.2
Benzo(b)fluoranthene	SW 0270	ng/kg	0.5			ND	290	8.9
Benzo(g,h,i)perylene	SW 0270	ng/kg	0.5			ND	130	5.5
Benzo(k)fluoranthene	SW 0270	ng/kg	0.5			ND	ND	ND
Chrysene	SW 0270	ng/kg	0.5			ND	340	11
Dibenzo(a,h)anthracene	SW 0270	ng/kg	0.5			ND	50	ND
Dibenzofuran	SW 0270	ng/kg	0.5			ND	620	ND
Fluoranthene	SW 0270	ng/kg	0.5			ND	770	20
Fluorene	SW 0270	ng/kg	0.5			ND	970	1.5
Indeno(1,2,3-c,d)pyrene	SW 0270	ng/kg	0.5			ND	150	6.4
2-Methylnaphthalene	SW 0270	ng/kg	0.5			ND	24	ND
Naphthalene	SW 0270	ng/kg	0.5			ND	610	0.8
N-Nitrosodiphenylamine	SW 0270	ng/kg	0.5			ND	2.7	ND
Phenanthrene	SW 0270	ng/kg	0.5			ND	740	18
Pyrene	SW 0270	ng/kg	0.5			ND	700	19
Semi-Quantified SW 0270 Compounds								
C14H10O2 Compound	SW 0270	ng/kg	1			ND	ND	1
C15H10 Hydrocarbon	SW 0270	ng/kg	1			ND	ND	1
Area. C15H12 Hydrocarbon(1)	SW 0270	ng/kg	10			ND	70	ND
Area. C15H12 Hydrocarbon(2)	SW 0270	ng/kg	10			ND	100	ND
Area. C16 Hydrocarbon	SW 0270	ng/kg	10			ND	40	ND
Area. C17H12 Hydrocarbon	SW 0270	ng/kg	10			ND	70	ND
Area. C18H12 Hydrocarbon	SW 0270	ng/kg	10			ND	50	ND
Benzopyrene Isomer	SW 0270	ng/kg	10			ND	70	ND
Substituted Phenanthrene	SW 0270	ng/kg	10			ND	100	ND
Bryogenated C14 Compound	SW 0270	ng/kg	10			ND	100	ND
Corbazole (C12H8O)	SW 0270	ng/kg	10			ND	90	ND
Dibenzothiophene (C12H8S)	SW 0270	ng/kg	10			ND	70	ND
Nitrogenated Compound	SW 0270	ng/kg	1			ND	ND	1
C10-C20 Hydrocarbon Matrix	SW 0270	ng/kg	1			ND	ND	ND
C25-C35 Hydrocarbon Matrix	SW 0270	ng/kg	1			ND	ND	ND
Methylene chloride	SW 0240	ng/kg	0.6			1	ND	0.9
Trichloroethylene	SW 0240	ng/kg	0.4			ND	ND	ND
Moisture in soil		Percent				47	8	26

o = Where no values are given, parameter is not regulated.

oo = Quantification based upon comparison of total ion count of the compound with that of the nearest internal standard.

water samples collected from both the upper and lower reaches of Mason's Run contained oil and grease concentrations from 1.1 to 2.3 mg/L. The highest concentrations of petroleum products found at Site 5, however, were in sediment samples, particularly those collected upstream from the concrete weir located on the southern extent of Mason's Run. Here concentrations ranged from 1,766 to 7,325 mg/kg, while oil and grease values in sediments from the northern extent ranged from 72.9 to 454 mg/kg. During the Stage 2 investigation, the sediment sample collected immediately upstream from the concrete weir at station SD503 contained a total petroleum product (semi-quantified SW8270 compounds) concentration of 760 mg/kg. Also of importance in this sample were the individual PAHs detected in concentrations ranging from 2.7 to 970 mg/kg. It should be noted, however, that the extent of sediment found at this location during the Stage 2 field investigation was limited (<1 cubic yard); the field team could barely find enough sediment on the concrete bottom from which to collect a sediment sample. About 100 feet downstream from the weir, PAH concentrations in the sediment sample collected at station SD501 ranged from 1.5 to 20 mg/kg. PAHs were not detected in any of the surface water or groundwater samples collected at Site 5.

Other organic compounds detected at Site 5 were 1,1,1-trichloroethane (1,1,1-TCA), trichloroethylene (TCE), bromodichloromethane (BDCM), chloroform, and methylene chloride. During the Stage 1 investigation, 1,1,1-TCA was detected in one surface water sample (5SW2) at a concentration of 1.6 $\mu\text{g/L}$ at the downstream sampling point, and during Stage 2, it was detected at concentrations of 0.5 and 1.1 $\mu\text{g/L}$ at the same location. TCE, BDCM, and chloroform were also detected at this surface water sampling location at concentrations of 0.5 to 1.6 $\mu\text{g/L}$, 1.0 to 5.6 $\mu\text{g/L}$, and 1.3 to 3.8 $\mu\text{g/L}$, respectively. Methylene chloride was detected in two Stage 2 sediment samples (SD502 and SD501) in concentrations of 1.0 and 0.9 mg/kg, respectively. None of the above organics were detected in any of the soil, sediment (except for the methylene chloride described above), or groundwater samples collected.

Total dissolved solids (TDS) and sulfate were detected in both groundwater and surface water samples. TDS in well PG501 was reported at 464 mg/L during

Stage 1 and 570 mg/L during Stage 2. In well PG502 it was reported at 1,162 mg/L during Stage 1 and 1,020 mg/L during Stage 2. TDS was 860 mg/L in well 5MW3; in well 5MW4 TDS was 2,500 mg/L. TDS concentrations in surface water samples ranged from 330 to 678 mg/L. Sulfate was detected in all groundwater samples collected, with concentrations ranging from 73.6 to 556 mg/L, and in surface water samples, values ranged from 49.2 to 80.3 mg/L.

A number of metals were detected in all of the sampling media at this site. Because of the large number of metals and the fact that they are naturally occurring, only those with current or proposed primary MCLs in groundwater will be discussed and compared to background levels from the AF Plant 85 perimeter wells (see Section 4.1.3.3). The exceptions to this are the metals found in sediment samples, which will also be compared to U.S. EPA guidelines developed by Region V for the evaluation of Great Lakes harbor sediments (USEPA, 1977) and to other literature guidelines.

Results from the aquatic survey conducted on Mason's Run are presented in full in Appendix I. Seining the creek at both locations did not produce any fish, suggesting that none were inhabiting either stretch of Mason's Run during the time of the survey. Results of the benthic survey indicated that the diversity of organisms upstream and downstream of the facility are essentially the same. Also, the five taxa which dominated the upstream and downstream sites are similar. However, there were significantly higher population densities upstream than downstream.

The overall conclusion of the aquatic survey is that the upstream site can support a higher density of organisms similar in composition to the downstream site. The reduced densities at the downstream site may be due to the habitat differences, contaminant differences in the sediments, or a combination of the two. The upstream bottom habitat was more complex with algal mats, detritus, and soft mud available to benthic organisms for food and shelter. The downstream habitat consisted largely of bare rock with the absence of a thick layer of detritus. Additionally, of the 55 semi-volatile organic contaminants tested for in the sediments at both sites, 16 were detected downstream; none were detected upstream.

4.1.3.2 Sampling or Analytical Problems

One sampling problem was encountered during the RI/FS, Stage 2 field investigation. Concentrations of purgeable halocarbons (Method 8010) were detected in sample 5SW2. This requires a second column confirmation which was neglected for this sample. The sample was collected on 8 December 1988 from the downstream sample location. This location was resampled on 15 March 1989, during which both a downstream and an upstream sample were obtained. The sample results from both sampling rounds confirm the presence of purgeable halocarbons. No duplicate samples were taken at this site.

4.1.3.3 Significance of Findings

In determining the significance of contaminants found at Mason's Run, chemical concentrations will be compared with the current and proposed federal primary MCLs, where established for parameters in groundwater. The state of Ohio adopted the federal MCLs as state standards in May 1989. As no federal or state regulatory standards exist for contaminants in soils, guidelines from the literature will be used for comparison. The primary source used for this comparison is the state of California's Designated Levels, which were developed for analytes in soils at a hypothetical "average" site. These levels were developed by the California Regional Water Quality Control Board to show the use of this methodology in generating contaminant threshold levels in soils for the protection of groundwater and surface water resources. Since these designated levels were computer-generated using specific soil types found in California, caution should be used in comparing these to the concentrations, particularly inorganic, found in soil samples collected at AF Plant 85. These levels were established for illustrative purposes only, and they have no official status or legal significance, even in California. Where California designated levels were not provided for a particular analyte, other literature sources were consulted and the same precautions should be applied in these comparisons as well.

No federal standard exists for the presence of oil and grease in soils. However, the free petroleum products which tend to stress the environment most are gasoline and diesel fuels (C4 to C12 and C10 to C23 hydrocarbons, respectively). The fuel components of major concern are benzene, toluene, xylene, and ethylbenzene (BTX&E) because: 1) they are a serious threat to human health; 2) they have the potential to move through soil and contaminate groundwater; and 3) their vapors are highly flammable and explosive. The hydrocarbons (semi-quantified SW 8270 compounds) detected in the Stage 2 sediment samples collected from Mason's Run tended to be heavier than those in gasoline and diesel and no BTX&E were detected, suggesting that the above risks would not be present. The highest concentration of oil and grease (2.3 mg/L during Stage 1) detected in surface water collected from Mason's Run did not exceed the state of Ohio wastewater discharge limit of 10 mg/L for these compounds. Ohio also has adopted a marginally enforceable water quality standard which states that surface water must be "free from floating debris, oil, scum and other floating materials entering waters as a result of human activity in amounts sufficient to be unsightly or cause degradation."

The California designated level for PAH compounds in soils is 0.0028 mg/kg. All PAH concentrations detected in the sediment sample collected during Stage 2 at station SD503 (immediately upstream from the concrete weir) and station SD501 (about 100 feet downstream from the weir) exceed this level, with values ranging from 2.7 to 970 mg/kg and 0.8 to 20 mg/kg, respectively. In addition, the tentative Netherlands soil criteria list the concentration of 20 mg/kg (dry weight) total PAHs as the delimiting value for soil quality having potential for harmful effects on human health or the environment and requiring further investigation (Fitchko, 1989). Total PAHs for these contaminated sediment samples were over 7,000 mg/kg at SD503 and over 100 mg/kg at SD501.

None of the remaining organic compounds detected at Site 5 exceeded their MCLs. It is interesting to note, however, a possible source of the BDCM and chloroform found in surface water collected from station 5SW2. These two compounds are grouped collectively with bromoform and dibromochloromethane (DBCM) into total trihalomethanes (TTHM). A water sample taken directly from

a water spigot at Building 124, located about 50 yards south of the James Road Hazardous Waste Pad (Site 8), was also analyzed for TTHMs. Here, BDCM was detected at a concentration of 3.7 $\mu\text{g/L}$, chloroform at 66 $\mu\text{g/L}$, and DBCM at 0.6 $\mu\text{g/L}$. Data received from Ohio EPA regarding water quality of drinking water processed at the Morse Road Water Treatment Plant shows the presence of TTHMs (see Appendix I). This suggests that the presence of these compounds in surface water at Mason's Run could be due to discharges of potable water supplied to the Plant by the Morse Road Water Treatment Plant. The state of Ohio regulates these four compounds as TTHMs and stipulates that their collective concentrations do not exceed 100 $\mu\text{g/L}$. The federal MCL for TTHMs is also 100 $\mu\text{g/L}$. The combined concentrations of the TTHM compounds found in the surface water of Mason's Run do not exceed the state or federal limit.

Although no primary MCLs have been established for TDS, this analyte warrants discussion due to its high concentrations. All TDS groundwater values except one exceeded the secondary MCL (500 mg/L) established for TDS. Secondary standards are recommended, nonenforceable limits for a public water supply system. Concentrations ranged from 464 to 2,500 mg/L, with the highest concentrations found in the downstream monitoring wells. In surface water samples, four of the eight TDS concentrations exceeded the secondary MCL, with the highest concentrations found at the upstream sampling locations. The significance of these high TDS values could be diminished by the fact that TDS concentrations found in groundwater samples collected from each of the perimeter wells during Stage 2 investigations also exceeded the secondary MCL. However, four of the TDS concentrations at Site 5 also exceeded the HNBL computed for TDS using data gathered from the perimeter wells (745 mg/L). Downstream values were 1,162 and 1,020 mg/L (Stage 1 and Stage 2, respectively) in well PG502 and 2,500 mg/L in well 5MW4 (Stage 2); the upstream value was 860 mg/L in well 5MW3. It should also be noted that two sulfate concentrations (556 and 340 mg/L) detected in well PG502 exceeded the secondary MCL (250 mg/L) established for this parameter.

Concentrations of metals detected in groundwater and surface water samples were compared to current and proposed primary MCLs (where established) and to

estimated background levels for groundwater computed for AF Plant 85 (Table 4-14). It was found that none of the regulated metals detected in either the groundwater or surface water samples collected at Mason's Run exceeded their present MCL or their HNBL. In addition, none of the regulated metals detected in soil samples exceeded the California Designated Levels. However, the sediment samples collected from along Mason's Run during Stage 2 do contain very high concentrations of metals as compared with the guidelines discussed below.

Metal concentrations will be compared to U.S. EPA guidelines developed by Region V for the evaluation of Great Lakes harbor sediments (USEPA, 1977) and to the Apparent Effect Threshold (AET) sediment quality values for some metals. The AET values are based on Puget Sound data for benthic infaunal analysis; the sediment concentration of a contaminant is identified above which statistically significant biological effects (e.g., mortality, benthic infaunal population decreases) would always be expected (Fitchko, 1989). The EPA guidelines, developed to address the disposal of dredged material, have not been adequately related to the impact of the sediments on the lakes, and are considered interim guidelines until more scientifically sound guidelines are developed. Sediments are classified as heavily polluted, moderately polluted, or non-polluted based on contaminant concentration range.

Table 4-22 shows the comparisons between the above guidelines and selected metals found in sediment samples collected along Mason's Run. According to the table, sediment samples collected at each of the sampling stations during Stage 2 exhibit moderate to heavy pollution characteristics. However, it should be noted that: 1) metals are not regulated in sediments and 2) the comparisons are with guidelines only.

4.1.3.3.1 Zones of Contamination. The primary zone of contamination is the sediment along the lower reaches of Mason's Run, both upstream and downstream from the concrete weir. The secondary zone of contamination is the groundwater found in the same vicinity as the contaminated sediments.

Table 4-22
Comparison of Selected Metals Values for Sediment Samples
Collected at Sites 5 and 10 During Stage 2 with Literature Guidelines.

Parameter	Concentrations* of Metals in Sediment Samples at AF Plant 85				Concentrations* from EPA Guidelines for Pollutional Classification of Great Lakes Harbor Sediments				AET Sediment Quality Values* for Benthic Infaunal Analysis
	Mason's Run			Turkey Run	Non-polluted (<)	Moderately Polluted	Heavily Polluted (>)		
	SD501	SD502	SD503	10SW1				10SW2	
Barium	240	98	51	110	130	20	20-60	60	-
Cadmium	4	ND	13	1	ND	**	**	6	58
Chromium	40	10	40	20	20	25	25-75	75	59
Copper	31	45	36	24	40	25	25-50	50	310
Iron	30,000	21,000	6,000	24,000	21,000	17,000	17,000-25,000	25,000	37,000
Manganese	450	470	280	470	280	300	300-500	500	>1,000
Nickel	30	25	4	26	26	20	20-50	50	49
Zinc	180	400	400	190	500	90	90-200	200	200

* = All concentrations given in mg/kg dry weight.

- = Value not established for this parameter.

** = Lower limits not established.

ND = Parameter not detected in sample.

Note: Guideline values were found in Fitchko, 1989.

The sediment samples of concern were collected just upstream (SD503) and about 100 feet downstream (SD501) of the oil skimmer system/concrete weir. Both of these samples showed the presence of polycyclic aromatic hydrocarbons (PAHs). None of these compounds were detected in the upstream sample, SD502. As PAHs are found in petroleum products, the likely source of these contaminants is the oil from past spills trapped in or leaking from the skimmer system. Although the volume of sediments contaminated with PAHs is quite small (<1 cubic yard) and concentrations of these compounds are not regulated by either the federal or state standards, a baseline risk assessment has been prepared due to the toxicity of the compounds found. Also of concern in these sediment samples are the high concentrations of petroleum products and heavy metals. However, a baseline risk assessment will not be prepared on these constituents, for which no regulatory standards exist.

Wells PG502 and 5MW4 are approximately 300 feet downgradient of the Coal Pile, Site 2. The former coal pile was located in a fenced, paved area and in 1979, an underground drainage system leading to a collection sump was installed. Leachate was collected in a sump and pumped to the Industrial Waste Water Treatment Plant, where it was neutralized and discharged to the sanitary sewer system. The actual coal pile was removed in June 1988 (Gerardi, 1989) and a site inspection during the Stage 2 field investigation revealed that no evidence of coal or coal dust could be found. Prior to 1979, the leachate, which contained sulfuric acid and trace metals, was released into Mason's Run. This leachate may have permeated into the groundwater of the till, the uppermost water-bearing zone, contributing to the high TDS and sulfate values.

4.1.3.3.2 Contaminant Migration. The presence of higher PAH concentrations in the sediment upstream of the weir as compared to the sample collected downstream indicates that, although the weir is impeding sediment transport, some of the contaminant-laden sediment is migrating downstream. Sediment transport from behind the weir would be via the surface water in Mason's Run. Although these compounds were not detected in the surface water, their presence in sediment sample SD501, collected 100 feet downstream from the weir, suggest that they are transported during times of heavy precipitation or

other activities in the vicinity of the weir which would disturb the dammed sediments.

The possibility exists for the high TDS and sulfate concentrations to migrate through the groundwater. However, the hydraulic conductivity in the till is estimated to be between 10^{-6} and 10^{-8} cm/sec. According to the EPA Hazardous Ranking System, the hydraulic conductivity range for various materials is $>10^{-3}$ to $<10^{-7}$ cm/sec. This would suggest that any contaminants found at this site would not migrate through the groundwater readily.

4.1.3.3.3 Baseline Risk Assessment. A baseline risk assessment was prepared for PAHs to aid in determining the risk to human health and the environment from contaminants found at Mason's Run.

Waste characterization. The organic chemicals found in the sediments are classified as polynuclear or polycyclic aromatic hydrocarbons (PAHs), which are a class of compounds consisting of substituted and unsubstituted polycyclic aromatic rings formed by incomplete combustion of organic materials. They are derived from the distillation of coal tar and are found in the heavier petroleum and coal tar products, such as oil and asphalt (Sax and Lewis, 1987; R. Miller, pers. com., 1989).

Data gathered on this group of chemicals have been largely inferred from research conducted on benzo(a)pyrene, which will be used here as the representative compound. The physical, chemical, and fate data for the compound are presented on Table 4-3.

The K_{OC} for this compound is 5,500,000 ml/g, indicating a very high affinity for soil or sediment. The K_{OW} for benzo(a)pyrene is 6.06, which is relatively high and indicates that the PAHs would strongly adsorb to suspended particulate matter, especially those high in organic matter (Clement Associates, 1985). The water solubility for this PAH is 1.20×10^{-3} mg/L, indicating that benzo(a)pyrene is not very soluble in water.

The toxicity data for benzo(a)pyrene are given in Table 4-5. The carcinogenic potency factor is $11.5 \text{ mg/kg/day}^{-1}$ using the oral route (SPHEM, 1986). At a cancer risk of 10^{-4} , the acceptable benzo(a)pyrene dose for short-term exposure (i.e., during a one-month remediation effort) for a 70 kg person is 0.50 mg/day; for a 10^{-6} cancer risk, the short-term dose is 0.005 mg/day (AGWSE, 1989). (70 kg is the average weight of an individual; SPHEM, 1986).

Of the PAHs found at Mason's Run, those with sufficient evidence to be classified as carcinogenic in animals include: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-c,d)pyrene. Chrysene has limited evidence of carcinogenicity. Data are inadequate to assess whether benzo(g,h,i)perylene, fluorene, and phenanthrene are carcinogenic. The available data provide no evidence that anthracene, fluoranthene, and pyrene are carcinogenic. Those chemicals which have been found to be carcinogenic have also been found to be mutagenic (Clement Associates, 1985). The EPA weight-of-evidence category for benzo(a)pyrene is Group B2, a probable carcinogen, indicating that there is sufficient evidence of carcinogenicity in animals, but inadequate evidence in humans.

In a study of benthic organisms in Puget Sound, it was found that PAH concentrations ranging from 0.5 to 8.0 mg/kg dry weight in sediments had a statistically significant effect on the biota. Concentrations above these values resulted in mortality and benthic infaunal population decreases (Fitchko, 1989).

Source and release characterization. Although the actual sources of PAHs in the sediment at Mason's Run are not known, it is likely that they are the oil and other petroleum products from the numerous spills which the run has received over the years (R. Miller, pers. com., 1989). The PAH-contaminated sediments were found just behind the oil skimmer; therefore, the oil could have actually been coming from the skimmer itself, either because of leaks or because some of the petroleum product could have spilled during skimmer drainage.

Once thought to be a possible source of PAHs, the upstream Coal Pile (Site 2) has been deleted from consideration due to the nature of PAHs. These organic contaminants are derived from coal tar, which is distilled from boiling coal at high temperatures (R. Miller, pers. com., 1989). There is no process at the Plant site which produces coal tar and the environmental conditions at the Coal Pile were not conducive to producing coal tar while the coal was in storage. In addition, analyses of coal leachates do not reveal the presence of PAHs.

Transport media and fate of contamination. The transport medium for PAHs at Mason's Run is via sediment migration in surface waters. PAHs are adsorbed to suspended particulate matter, especially those high in organic content. The available information suggests that these compounds can accumulate in the sediment and biotic portions of the aquatic environment, and that physical movement of the sediments or uptake in the food chain are probably the dominant aquatic transport processes.

PAHs could reach groundwater by leaching from the polluted sediment; however, these chemicals are only slightly soluble in water (1.20×10^{-3} mg/L) and no evidence of these contaminants was found in the wells monitoring this site. In surface waters any dissolved PAHs would probably undergo rapid and direct photolysis. Oxidation of these chemicals by chlorine and ozone is possible if sufficient quantities of these catalysts are present. No PAHs were found in the surface water of Mason's Run.

The chemicals can be bioaccumulated but are found to metabolize quickly and then be eliminated. Bioaccumulation and biodegradation are probably the ultimate fate processes for PAHs. The available data suggest that the PAHs with high molecular weights are degraded slowly by microbes and readily metabolized by multicellular organisms. Microbes appear to degrade PAHs much more completely than mammals. (Clement Associates, 1985.)

Receptors, exposure points, and exposure routes. The most likely transport mechanism at Site 5 is the migration of contaminants in the sediment via the surface water found in Mason's Run. This is largely due to the low solubility of PAHs in water and their affinity for sediments and organic matter.

The primary routes of exposure would be dermal contact with the sediments or ingestion of fish. No fish were seen during the ecology study, although a school of small fish was noted during the Presurvey of Phase II. This would indicate that the receptors are those users downstream, the most immediate being the community of Whitehall. However, due to the very small amount of contaminant-laden sediments (<1 cubic yard), the likelihood that enough of the compounds would come into contact with human receptors is negligible.

Threat to human health and wildlife. The concentrations of PAHs immediately upstream from the oil/water separator varied between 50 to 970 mg/kg, which are relatively high values when compared to the acceptable short-term dose allowance of 0.05 mg/day (AGWSE, 1989). Also, these concentrations are much higher than those given in the Puget Sound study of benthic organisms. The benthic study on Mason's Run did indicate a significant reduction in density, or numbers of individuals within a genus, from the upstream site. This, however, could be attributed to the type of substrate (creek bottom) found at the downstream location, which is not conducive to benthic colonization. Because the area of contaminated sediments is so limited, it is doubtful that these PAHs would have an adverse impact on either human health or the environment. However, due to the carcinogenic nature of many of the PAHs, there is some risk at the site. This risk can be alleviated with the removal of approximately 1 cubic yard of sediment (a very minor remedial action that does not warrant a TDSRAA) and through better maintenance of the oil/water separator system. In fact, it recently was reported that sediments under the oil skimmer are now regularly removed by the Plant operator (Carl Stoltz, writ. com., 1990).

4.1.4 Discussion of Results for Turkey Run (Site 10)

Approximately 375 feet of Turkey Run traverses the western edge of AF Plant 85; of this, roughly 60 feet are contained in a steep-sided open concrete culvert (Figures 1-2 and 4-9). After passage through the Port Columbus International Airport, Turkey Run joins Mason's Run approximately 2 miles south of the AF Plant 85.

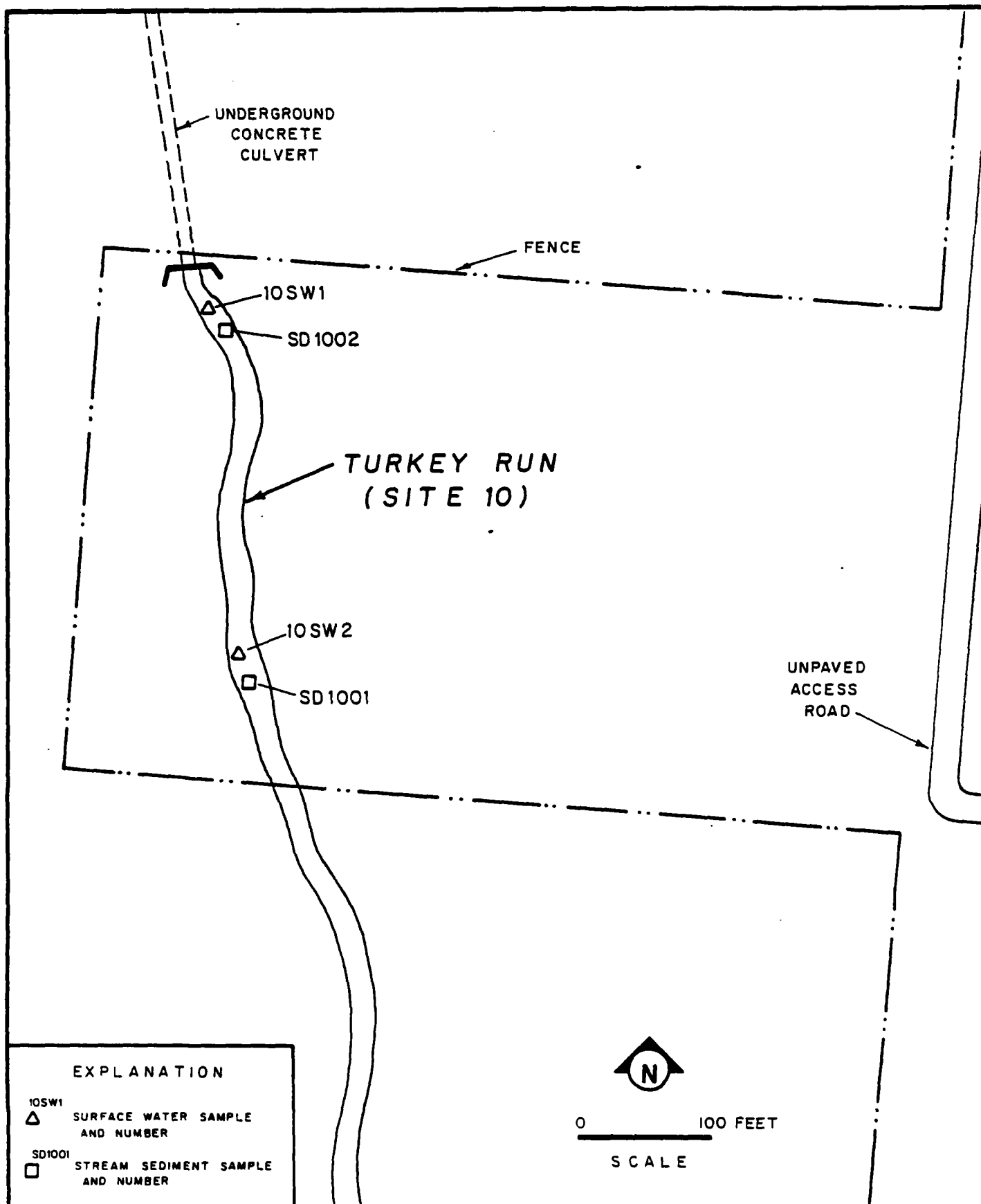


Figure 4-9. Site map for Turkey Run (Site 10).

4.1.4.1 Presentation of Results

4.1.4.1.1 Site Geology. Turkey Run traverses the Pewamo--Urban Land Complex soil type, which has a characteristic permeability of 1×10^{-4} to 4×10^{-4} cm/sec. Two sediment samples were collected and analyzed for grain size distribution and percent moisture; 71% were silt- to clay-sized particles.

4.1.4.1.2 Site Hydrology. Turkey Run is an intermittent stream which recharges the groundwater in the fall, following a rainfall event, and discharges groundwater in the spring.

4.1.4.1.3 Analytical Results. During Stage 2, two surface water samples and two sediment samples were submitted for chemical analyses. Figure 4-9 show the sample locations. Table 4-23 presents the analytical data for the surface water samples and Table 4-24 presents the analytical data for the sediment samples.

4.1.4.1.4 Discussion of Analytical Data. Methylene chloride was the only organic compound detected in samples collected from Turkey Run. It was found in both sediment samples at a concentration of 1.0 mg/kg.

A number of metals were detected in both the surface water and sediment samples collected at this site. Because of the large number of metals and the fact that they are naturally occurring, only those with current or proposed primary MCLs in groundwater will be discussed and compared to background levels from the AF Plant 85 perimeter wells (see Section 4.1.3.3). The one exception to this is the metals found in sediment samples, which will also be compared to U.S. EPA guidelines developed by Region V for the evaluation of Great Lakes harbor sediments (USEPA, 1977) and to other literature guidelines.

4.1.4.2 Sampling or Analytical Problems

No sampling or analytical problems were encountered at this site and no field duplicates or blanks were collected.

TABLE 4-23

ANALYTICAL DATA FOR SURFACE WATER SAMPLES COLLECTED AT TURKEY RUN (SITE 10)
DURING RI/FS, STAGE 2, AF PLANT 85

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels(a)		Site		Sample Type Date Coll.	12/08/88 085-SW-010-001 8812152+1	12/08/88 085-SW-010-002 8812152+2		
				Federal	State	Station	10					
											10SV2	10SV1
*Total Dissolved Solids	E100.1	mg/L	10	500.0	500.0		490	500				
Chloride	E300	mg/L	0.5	250.0	250.0		40	25				
Fluoride	E300	mg/L	0.5	4.0	4.0		ND	ND				
*Sulfate	E300	mg/L	1.0	250.0	250.0		68	68				
Antimony	SW 6010	mg/L	0.3				ND	ND				
Barium	SW 6010	mg/L	0.004	1.0(5.0)	1.0		0.004	0.004				
Beryllium	SW 6010	mg/L	0.001				ND	0.003				
Cadmium	SW 6010	mg/L	0.2	0.01(0.005)	0.01		ND	ND				
Calcium	SW 6010	mg/L	0.01				83	88				
Chromium	SW 6010	mg/L	0.04	0.05	0.05		ND	ND				
Cobalt	SW 6010	mg/L	0.04				ND	ND				
Copper	SW 6010	mg/L	0.02	1.0(1.3)	1.0		ND	0.07				
*Iron	SW 6010	mg/L	0.02	0.3	0.3		0.07	0.06				
Magnesium	SW 6010	mg/L	0.01				26	27				
Manganese	SW 6010	mg/L	0.005	0.05	0.05		0.056	0.061				
Molybdenum	SW 6010	mg/L	0.2				ND	ND				
Nickel	SW 6010	mg/L	0.04				ND	ND				
Potassium	SW 6010	mg/L	0.6				2.7	3.7				
Silver	SW 6010	mg/L	0.02	0.05(+)	0.05		ND	ND				
Sodium	SW 6010	mg/L	0.1				31	38				
*Zinc	SW 6010	mg/L	0.03	5.0	5.0		0.07	0.22				
Arsenic	SW 7000	mg/L	0.002	0.05	0.05		ND	ND				
Lead	SW 7421	mg/L	0.002	0.05(0.005)	0.05		0.002	0.003				
Mercury	SW 7470	mg/L	0.0006	0.002	0.002		ND	ND				
1,1,1-Trichloroethane	SW 8010	ug/L	0.5	200.0	200.0		ND	ND				
Bromodichloromethane	SW 8010	ug/L	0.5	100.0 + 100.0 +			ND	ND				
Chloroform	SW 8010	ug/L	0.2	100.0 + 100.0 +			ND	ND				
Dibromochloromethane	SW 8010	ug/L	0.5	100.0 + 100.0 +			ND	ND				
Freon 113	SW 8010	ug/L	0.5				ND	ND				
Methylene chloride	SW 8010	ug/L	2				ND	ND				
Trichloroethylene	SW 8010	ug/L	0.5	5.0	5.0		ND	ND				
Toluene	SW 8020	ug/L	0.5	(2000.0)			ND	ND				
Semi-volatile Organics	SW 8270	ug/L					ND	ND				

* = Parameters with secondary maximum contaminant levels for standards.

ND = Not detected.

(a) = Where no values are given, parameter is not regulated.

() = Standards listed in parentheses are proposed Federal MCLs with the final rule expected in 1998.

+ = For total trihalomethanes group.

TABLE 4-24

ANALYTICAL DATA FOR SEDIMENT SAMPLES COLLECTED AT TURKEY RUN (SITE 10)
DURING RI/FS, STAGE 2, AF PLANT 85

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels		Site Station	SD	10 SW1	SD	10 SW2
				Federal	State	Depth	0.0-0.5	0.0-0.5	0.0-0.5	0.0-0.5
						Sample Type				
						Date Coll.	12/08/88	12/08/88	12/08/88	12/08/88
						Field No.	005-SD-010-002	005-SD-010-001	005-SD-010-001	005-SD-010-001
						Lab No.	001215642	001215641	001215641	001215641
Silver	SW 0010	ug/kg	0.5					2.3		3
Aluminum	SW 0010	ug/kg	5					9000		9500
Barium	SW 0010	ug/kg	0.1					110		130
Beryllium	SW 0010	ug/kg	0.03					0.52		0.35
Calcium	SW 0010	ug/kg	0.3					13000		63000
Cadmium	SW 0010	ug/kg	0.5					1		ND
Cobalt	SW 0010	ug/kg	1					6		2
Chromium	SW 0010	ug/kg	1					20		20
Copper	SW 0010	ug/kg	0.5					24		40
Iron	SW 0010	ug/kg	0.5					24000		21000
Potassium	SW 0010	ug/kg	20					890		1100
Magnesium	SW 0010	ug/kg	0.3					5000		10000
Manganese	SW 0010	ug/kg	0.1					470		200
Sodium	SW 0010	ug/kg	3					87		170
Nickel	SW 0010	ug/kg	1					20		20
Vanadium	SW 0010	ug/kg	0.0					20		17
Zinc	SW 0010	ug/kg	0.0					190		500
Mercury	SW 7471	ug/kg	0.4					ND		ND
Acenaphthene	SW 8270	ug/kg	0.5					ND		ND
Anthracene	SW 8270	ug/kg	0.5					ND		ND
Benzo(a)anthracene	SW 8270	ug/kg	0.5					ND		ND
Benzo(a)pyrene	SW 8270	ug/kg	0.5					ND		ND
Benzo(b)fluoranthene	SW 8270	ug/kg	0.5					ND		ND
Benzo(g,h,i)perylene	SW 8270	ug/kg	0.5					ND		ND
Benzo(k)fluoranthene	SW 8270	ug/kg	0.5					ND		ND
Chrysene	SW 8270	ug/kg	0.5					ND		ND
Dibenzo(a,h)anthracene	SW 8270	ug/kg	0.5					ND		ND
Dibenzofuran	SW 8270	ug/kg	0.5					ND		ND
Fluoranthene	SW 8270	ug/kg	0.5					ND		ND
Fluorene	SW 8270	ug/kg	0.5					ND		ND
Indeno(1,2,3-c,d)pyrene	SW 8270	ug/kg	0.5					ND		ND
2-Methylnaphthalene	SW 8270	ug/kg	0.5					ND		ND
Naphthalene	SW 8270	ug/kg	0.5					ND		ND
N-Nitrosodiphenylamine	SW 8270	ug/kg	0.5					ND		ND
Phenanthrene	SW 8270	ug/kg	0.5					ND		ND
Pyrene	SW 8270	ug/kg	0.5					ND		ND
Semi-Quantified SW 8270 Compounds										
C14H8O2 Compound	SW 8270	ug/kg	1					ND		ND
C15H10 Hydrocarbon	SW 8270	ug/kg	1					ND		ND
Area. C8H12 Hydrocarbon(1)	SW 8270	ug/kg	10					ND		ND
Area. C8H12 Hydrocarbon(2)	SW 8270	ug/kg	10					ND		ND
Area. C10 Hydrocarbon	SW 8270	ug/kg	10					ND		ND
Area. C17H12 Hydrocarbon	SW 8270	ug/kg	10					ND		ND
Area. C18H12 Hydrocarbon	SW 8270	ug/kg	10					ND		ND
Benzo(a)pyrene Isomer	SW 8270	ug/kg	10					ND		ND
Substituted Phenanthrene	SW 8270	ug/kg	10					ND		ND
Bryogenated C14 Compound	SW 8270	ug/kg	10					ND		ND
Carbazole (C12H8N2)	SW 8270	ug/kg	10					ND		ND
Dibenzothiophene (C12H8S)	SW 8270	ug/kg	10					ND		ND
Nitrogenated Compound	SW 8270	ug/kg	1					ND		ND
C10-C20 Hydrocarbon Matrix	SW 8270	ug/kg	1					ND		ND
C25-C35 Hydrocarbon Matrix	SW 8270	ug/kg	1					ND		ND
Methylene chloride	SW 8240	ug/kg	0.0					1		1
Trichloroethylene	SW 8240	ug/kg	0.4					ND		ND
Moisture in soil		Percent						30		57

o = Where no values are given, parameter is not regulated.

oo = Quantification based upon comparison of total ion count of the compound with that of the nearest internal standard.

ND = Not detected.

— = Sample not analyzed for this parameter.

4.1.4.3 Significance of Findings

Methylene chloride was the only organic compound detected at Turkey Run. It was found in both sediments samples at a concentration of 1.0 mg/kg. No federal or state MCLs have been established for this chemical. Since these concentrations are very near to the detection limit for methylene chloride, there is a good possibility the these values are false positives.

Concentrations of metals detected in surface water samples were compared to current and proposed primary MCLs (where established) and to estimated background levels for groundwater computed for AF Plant 85 (Table 4-14). It was found that none of the regulated metals detected in the surface water samples collected at Turkey Run exceeded their MCL or their HNBL. The sediment samples collected from along Turkey Run during Stage 2 do contain very high concentrations of metals, which will be compared to U.S. EPA guidelines developed by Region V for the evaluation of Great Lakes harbor sediments (USEPA, 1977) and to the Apparent Effect Threshold (AET) sediment quality values for some metals based on Puget Sound data for benthic infaunal analysis (significant depression of total abundance) (Fitchko, 1989). The EPA guidelines, developed to address the disposal of dredged material, have not been adequately related to the impact of the sediments on the lakes, and are considered interim guidelines until more scientifically sound guidelines are developed. Sediments are classified as heavily polluted, moderately polluted, or non-polluted based on contaminant concentration range.

Table 4-22 lists the guidelines. In comparing the metals found in sediment samples collected from sampling stations 10SW1 and 10SW2 with these guidelines, it can be seen that iron, manganese, and nickel concentrations and barium and zinc concentrations at both stations exhibit moderate and high pollution characteristics, respectively. Additionally, at the downstream station the copper concentration is indicative of moderate pollution and the zinc concentration could be detrimental to benthic organisms.

4.1.4.3.1 Threat to Human Health or Wildlife. Several factors have been considered in determining that there is no evidence of an apparent threat to human health or the environment at Site 10, Turkey Run. First of all, the metals are apparently bound up in the sediments since concentrations of the same constituents in the surface water are low and do not exceed any MCLs; and, this surface water is not used as a source of drinking water. Access to the facility is restricted, which eliminates the possibility of incidental dermal contact with and ingestion of sediments by small children. Therefore, the possible threat to human health is not present. Perhaps the benthic community might be impacted by the presence of these high metals concentrations. However, according to the Ohio Division of Natural Areas and Preserves, the only endangered or threatened species or critical habitats within 5 miles of the facility are located upstream, to the northeast of Plant 85. Therefore, there is no risk of exposure to these environmentally sensitive areas from Plant activities around Turkey Run. Further, Turkey Run flows through a very industrialized setting and a healthy natural stream environment could not be achieved unless more than the Plant's 375-foot segment of this low-flowing stream were involved in cleanup activities. Finally, it should be recalled that no specific regulatory standards exist for metal concentrations in sediments.

4.1.5 Discussion of Results for Perimeter Monitoring Wells

Plant-wide monitoring was initiated at the beginning of the Stage 2 investigation to provide water quality data on groundwater influenced by Plant activities. This involved establishing upgradient monitoring wells to provide data on groundwater entering the Plant area and at downgradient wells to measure the quality of the groundwater leaving the Plant. These wells were established in shallow and deep water-bearing zones and are located along the perimeter of the facility (Figure 4-10). In addition, well PG-201, which was installed during the Stage 1 investigations at the Coal Pile Site (Site 2), was included with the Plant-wide monitoring system.

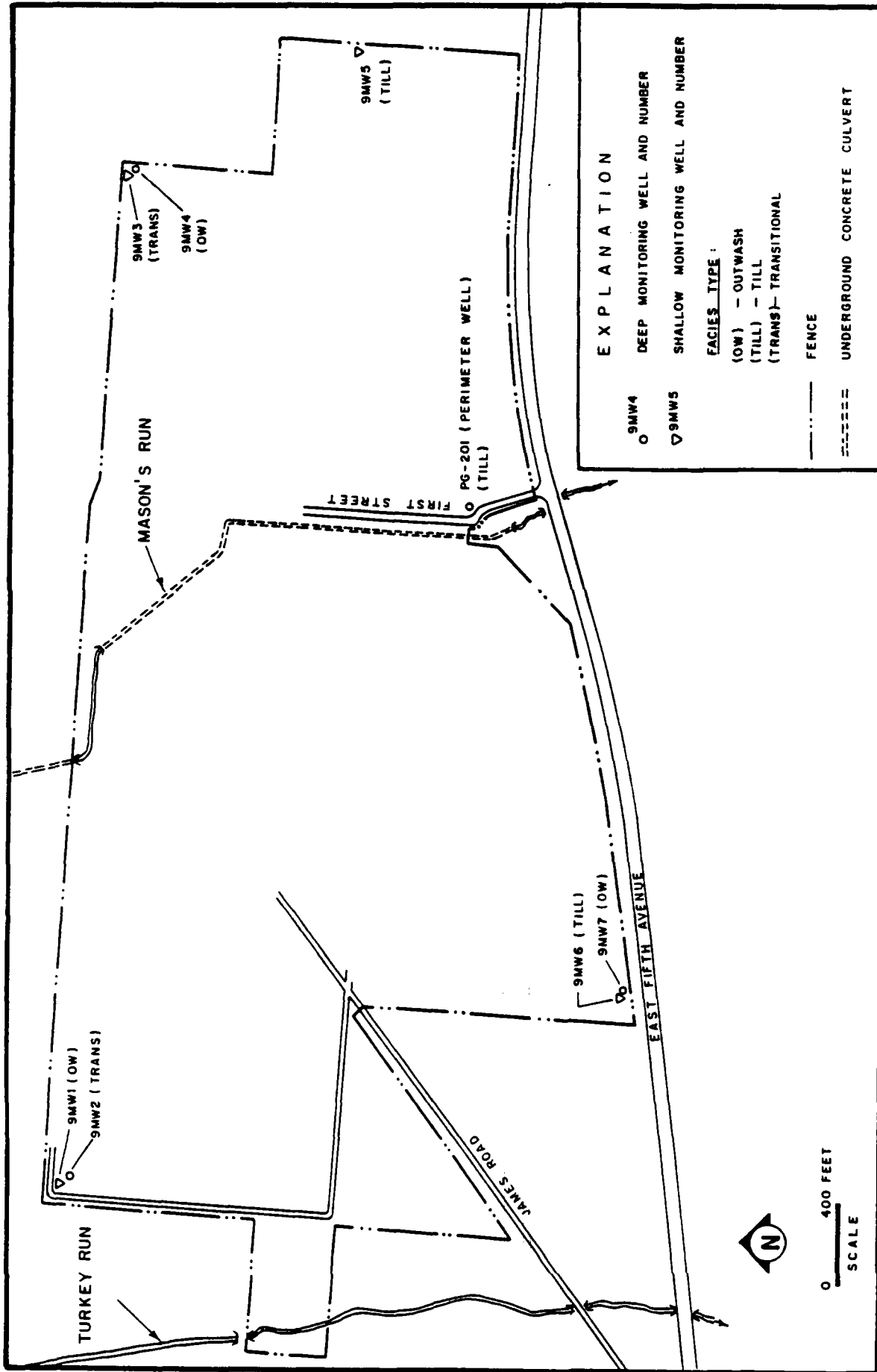


Figure 4-10. Location of Perimeter Wells, AF Plant 85.

4.1.5.1 Presentation of Results

4.1.5.1.1 Site Geology. During the installation of the seven Stage 2 perimeter wells (9MW1, 9MW2, 9MW3, 9MW4, 9MW5, 9MW6, and 9MW7), selected soil samples were collected and analyzed for grain size distribution, moisture content, and permeability. This information, along with the lithologic logs found in Appendix C, provided a greater understanding of the surficial geology at the facility.

In six of the perimeter wells, soil samples were collected from between 4 to 6 feet bgs for analyses. The percent distribution of silt- and clay-sized particles ranged from 41 to 81% with an average of 65% of the grains passing through the No. 200 sieve. The percent moisture averaged 22% and the permeability ranged from 1.12×10^{-8} to 2.5×10^{-8} cm/sec, averaging 1.57×10^{-8} cm/sec.

Three samples were taken from the interval from 13 to 15 feet bgs. The grain size distribution indicated that an average of 18% of the particles were silt- and clay-sized, ranging from 8 to 33%. The percent moisture averaged 14%. No coefficients of permeability could be calculated for these samples as the cores collected were too friable. In addition, the one soil sample collected from the 24- to 25.5-foot interval exhibited similar characteristics.

The information gathered from the above analyses and examination of the lithologic logs indicates that the Plant site is underlain with impermeable till material, ranging from 10 to 35 feet thick. This Late Stage Wisconsin till is comprised of mostly silty clay with some outwash features associated. In some boreholes (such as 9MW3) this till grades into the relatively well-sorted sand and gravel outwash of the Early Wisconsin Stage. Where found in the deeper boreholes (9MW4), this outwash is underlain by a thin layer of clay-rich till. In well 9MW7, located in the southwest corner, the outwash appears to be interbedded with till-like zones. No outwash was encountered in well 9MW5, the easternmost well.

Bedrock was encountered in well 9MW5 at 14 feet bgs and in well 9MW4, located roughly 1,200 feet to the northwest of well 9MW5, at 40 feet bgs. Bedrock was also encountered during the drilling of Stage 1 wells PG501 and PG502 at 45 and 51 feet bgs, respectively. It is expected that the bedrock in the western portion of the Plant lies approximately 200 feet bgs where a tributary of the preglacial Groveport River drainage is present.

4.1.5.1.2 Site Hydrology. The till is monitored by wells 9MW5, 9MW6, and PG201, while the outwash is monitored by wells 9MW1, 9MW4, and 9MW7. Wells 9MW2 and 9MW3 were screened in the transition zone between the till and outwash. The potentiometric surfaces for the shallow and deep wells are illustrated in Figures 2-5 and 2-6, respectively. Groundwater appears to be flowing to the southwest. These maps also show a small high or mound in the vicinity of the James Road Hazardous Waste Storage Pad. There is no obvious explanation for this feature.

Slug tests performed in these wells indicate hydraulic conductivities of between 1.3×10^{-2} to 8.8×10^{-3} cm/sec (Papadopulus and others method) and 1.2×10^{-2} to 4.6×10^{-2} cm/sec (Hvorslev method). These figures indicate the material is a silty to clean sand (Freeze and Cherry, 1979), which corresponds to the lithologic descriptions.

4.1.5.1.3 Analytical Results. One groundwater sample was collected from each of the eight wells in the perimeter system. The results are found on Tables 4-25 and 4-26. Soil samples collected from this site were not analyzed for chemical parameters.

4.1.5.1.4 Discussion of Analytical Data. Toluene was the only organic compound found in groundwater sampled from the perimeter wells. It was detected in 9MW4 at a concentration of $0.7 \mu\text{g/L}$. This value was not confirmed in the second column analysis; therefore, further discussion of this parameter is not warranted.

TABLE 4-26
ANALYTICAL DATA FOR GROUNDWATER SAMPLES COLLECTED AT PERIMETER WELLS
DURING PHASE II, STAGE 1, AF PLANT 08

Parameter	Method	Units	Detection Limits	Standards and Action Levels(a)		Station Sample Type Date Coll. Field No. Lab No.	PQ 291 -- 3/5/88 CP-88-2991 FJ-484	PQ 291 Dup 2991 3/5/88 CP-88-2992 FJ-485
				Federal	State			
Total Dissolved Solids	E 100.1	mg/L	1	500.0	500.0		450	450
Sulfate	E 300	mg/L	0.0005	250.0	250.0		41.0	42.4
Arsenic	E 200.2	mg/L	0.0034	0.05	0.05		0.0035	
Cadmium, Total	E 213.2	mg/L	0.0001	0.01(0.005)	0.01			
Cadmium, Dissolved	E 213.2	mg/L	0.0001	0.01(0.005)	0.01			
Chromium, Total	E 218.2	mg/L	0.001					
Chromium, Dissolved	E 218.2	mg/L	0.001					
Copper	E 220.2	mg/L	0.0012	1.0(1.3)	1.0		0.0073	
Lead, Total	E 230.2	mg/L	0.0005	0.05(0.005)	0.05		ND	
Lead, Dissolved	E 230.2	mg/L	0.0005	0.05(0.005)	0.05			
Manganese	E 243.2	mg/L	0.0005	0.05	0.05		0.113	
Nickel, Total	E 249.2	mg/L	0.001				0.0001	
Nickel, Dissolved	E 249.2	mg/L	0.001				0.0001	
Zinc	E 269.1	mg/L	0.002	5.0	5.0		0.016	
Total Organic Carbon	E 415.1	mg/L	0.005				1.5	
Total Organic Halides	SW 9020	ug/L	10				ND	
Oil and Grease	E 413.2	mg/l	0.1				2.1	
1,1,1-Trichloroethane	E 601	ug/L	1	200.0	200.0			
Chloroform	E 601	ug/L	1	100.0	100.0			
Aromatic VOCs	E 602	ug/L	1					

* = Parameters with secondary maximum contaminant levels for standards.

(a) = Where no values are given, parameter is not regulated.

ND = Not detected.

U = Sample not analyzed for this parameter.

T = Samples listed in parentheses are proposed Federal MCLs with the final rule expected in 1990.

. = For total trihalomethanes group.

TABLE 4-26

ANALYTICAL DATA FOR GROUNDWATER SAMPLES COLLECTED AT PERIMETER WELLS
DURING RI/FS, STAGE 2, AF PLANT 85

Parameter	Method	Units	Detection Limit	Standards and Action Levels(s) ----- Federal State	Station Sample Type Date Coll. Field No. Lab No.	QMW2			
						QMW1	AC Blank	Equip Blank	QMW2
						11/19/88 985-CW-889-001 8811330+1	11/21/88 985-CW-889-002 8811330+1	11/21/88 985-CW-889-003 8811330+4	11/21/88 985-CW-889-004 8811330+5
*Total Dissolved Solids	E100.1	mg/L	10	500.0 500.0		630	—	—	670
*Chloride	E300	mg/L	0.5	250.0 250.0		18	—	—	9.9
*Fluoride	E300	mg/L	0.5	4.0 4.0		ND	—	—	ND
*Sulfate	E300	mg/L	1.0	250.0 250.0		71	—	—	68
Antimony	SW 8010	mg/L	0.3			ND	—	—	0.4
Barium	SW 8010	mg/L	0.004	1.0(5.0) 1.0		0.25	—	—	0.45
Beryllium	SW 8010	mg/L	0.001			ND	—	—	0.001
Cadmium	SW 8010	mg/L	0.02	0.01(0.005) 0.01		ND	—	—	0.02
Calcium	SW 8010	mg/L	0.01			95	—	—	110
Cobalt	SW 8010	mg/L	0.04			ND	—	—	ND
Copper	SW 8010	mg/L	0.02	1.0(1.3) 1.0		ND	—	—	ND
*Iron	SW 8010	mg/L	0.02	0.3 0.3		0.04	—	—	0.03
Magnesium	SW 8010	mg/L	0.01			35	—	—	37
*Manganese	SW 8010	mg/L	0.005	0.05 0.05		0.3	—	—	0.23
Molybdenum	SW 8010	mg/L	0.2			ND	—	—	0.4
Nickel	SW 8010	mg/L	0.04			ND	—	—	ND
Potassium	SW 8010	mg/L	0.6			1.2	—	—	2.1
Silver	SW 8010	mg/L	0.02	0.05(+) 0.05		ND	—	—	ND
Sodium	SW 8010	mg/L	0.1			18	—	—	13
*Zinc	SW 8010	mg/L	0.03	5.0 5.0		ND	—	—	ND
Arsenic	SW 7060	mg/L	0.002	0.05 0.05		0.004	—	—	0.002
Lead	SW 7421	mg/L	0.002	0.05(0.005) 0.05		0.003	—	—	0.007
Mercury	SW 7470	mg/L	0.0008	0.002 0.002		ND	—	—	ND
1,1,1-Trichloroethane	SW 8010	ug/L	0.5	200.0 200.0		ND	—	—	ND
Bromodichloroethane	SW 8010	ug/L	0.5	100.0 + 100.0 +		ND	—	—	ND
Chloroform	SW 8010	ug/L	0.2	100.0 + 100.0 +		ND	—	—	ND
Dibromochloroethane	SW 8010	ug/L	0.5	100.0 + 100.0 +		ND	—	—	ND
Freon 113	SW 8010	ug/L	0.5			ND	—	—	ND
Methylene chloride	SW 8010	ug/L	2			ND	—	—	ND
Trichloroethylene	SW 8010	ug/L	0.5	5.0 5.0		ND	—	—	ND
Toluene	SW 8020	ug/L	0.5	(2000.0)		ND	—	—	ND
Semivolatile Organics	SW 8270	ug/L				ND	—	—	ND

* = Parameters with secondary maximum contaminant levels for standards.

(a) = Where no values are given, parameter is not regulated.

ND = Not detected.

+ = Sample not analyzed for this parameter.

() = Standards listed in parentheses are proposed Federal MCLs with the final rule expected in 1998.

+ = For total trihalomethanes group.

TABLE 4-28
ANALYTICAL DATA FOR GROUNDWATER SAMPLES COLLECTED AT PERIMETER WELLS
DURING RI/FS, STAGE 2, AF PLANT 86
(Continued)

Parameter	Method	Units	Detection Limit	Standards and Action Levels(a)	Federal	State	Station Sample Type Date Coll.	Field No.	Lab No.	QMW2 Trip Blank 1 11/21/86 885-CR-000-016 8811390+2	QMW2 Trip Blank 2 11/21/86 885-CR-000-016 8811390+9	QMW3 -- 11/23/86 885-CR-000-006 8811390+1	QMW4 1st Column 11/23/86 885-CR-000-007 8811394+1	QMW4 2nd Column 11/23/86 885-CR-000-007 8811394+5
•Total Dissolved Solids	E100.1	mg/L	10	500.0	500.0							710	630	
•Chloride	E300	mg/L	0.5	250.0	250.0							17	30	
•Fluoride	E300	mg/L	0.5	4.0	4.0							1.2	1.2	
•Sulfate	E300	mg/L	1.0	250.0	250.0							94	34	
Antimony	SW 0010	mg/L	0.3									ND	ND	
Barium	SW 0010	mg/L	0.004	1.0(5.0)	1.0							0.31	0.61	
Beryllium	SW 0010	mg/L	0.001									ND	ND	
Cadmium	SW 0010	mg/L	0.02	0.01(0.005)	0.01							ND	ND	
Calcium	SW 0010	mg/L	0.01									140	100	
Cobalt	SW 0010	mg/L	0.04									ND	ND	
Copper	SW 0010	mg/L	0.02	1.0(1.3)	1.0							ND	ND	
•Iron	SW 0010	mg/L	0.02	0.3	0.3							0.12	ND	
Magnesium	SW 0010	mg/L	0.01									50	57	
•Manganese	SW 0010	mg/L	0.005	0.05	0.05							0.5	0.20	
•Molybdenum	SW 0010	mg/L	0.2									ND	ND	
Nickel	SW 0010	mg/L	0.04									ND	ND	
Potassium	SW 0010	mg/L	0.0									4.8	5.4	
Silver	SW 0010	mg/L	0.02	0.05(•)	0.05							ND	ND	
Sodium	SW 0010	mg/L	0.1									27	28	
•Zinc	SW 0010	mg/L	0.03	5.0	5.0							0.08	ND	
Arsenic	SW 7000	mg/L	0.002	0.05	0.05							0.008	0.007	
Lead	SW 7421	mg/L	0.002	0.05(0.005)	0.05							ND	ND	
Mercury	SW 7470	mg/L	0.0000	0.002	0.002							ND	ND	
1,1,1-Trichloroethane	SW 0010	ug/L	0.5	200.0	200.0							ND	ND	
Bromodichloroethane	SW 0010	ug/L	0.5	100.0 •	100.0 •							ND	ND	
Chloroform	SW 0010	ug/L	0.2	100.0 •	100.0 •							ND	ND	
Dibromochloroethane	SW 0010	ug/L	0.5	100.0 •	100.0 •							ND	ND	
Freon 113	SW 0010	ug/L	0.5									ND	ND	
Methylene chloride	SW 0010	ug/L	2									ND	ND	
Trichloroethylene	SW 0010	ug/L	0.5	5.0	5.0							ND	ND	
Toluene	SW 0020	ug/L	0.5	(2000.0)								ND	0.7	ND
Semivolatile Organics	SW 0270	ug/L										ND	ND	

• = Parameters with secondary maximum contaminant levels for standards.

(•) = Where no values are given, parameter is not regulated.

ND = Not detected.

• = Sample not analyzed for this parameter.

• = Standards listed in parentheses are proposed Federal MCLs with the final rule expected in 1990.

• = For total trihalomethanes group.

TABLE 4-28

ANALYTICAL DATA FOR GROUNDWATER SAMPLES COLLECTED AT PERIMETER WELLS
DURING RI/FS, STAGE 2, AF PLANT 85
(Continued)

Parameter	Method	Units	Method Detection Limit	Standards and Action Levels(a)	Federal	State	Station Sample Type Date Coll. Field No. Lab No.	9MW5 -- 11/28/88 885-CW-889-888 8811424+2	9MW6 -- 11/29/88 885-CW-889-818 8811448+1	9MW7 -- 11/29/88 885-CW-889-889 8811441+1	PG201 -- 11/28/88 885-CW-882-881 8811424+1
*Total Dissolved Solids	E100.1	mg/L	10	500.0	500.0	500.0		570	530	700	500
*Chloride	E300	mg/L	0.5	250.0	250.0	250.0		44	25	50	12
Fluoride	E300	mg/L	0.5	4.0	4.0	4.0		0.9	0.8	1	1.8
*Sulfate	E300	mg/L	1.0	250.0	250.0	250.0		29	0.4	72	57
Antimony	SW 8010	mg/L	0.3					ND	ND	ND	ND
Barium	SW 8010	mg/L	0.004	1.0(5.0)	1.0			0.47	0.15	0.34	0.2
Beryllium	SW 8010	mg/L	0.001					ND	ND	ND	ND
Cadmium	SW 8010	mg/L	0.02	0.01(0.005)	0.01			ND	0.01	ND	ND
Calcium	SW 8010	mg/L	0.01					110	99	130	110
Cobalt	SW 8010	mg/L	0.04					ND	0.05	ND	0.04
Copper	SW 8010	mg/L	0.02	1.0(1.3)	1.0			0.21	ND	ND	ND
*Iron	SW 8010	mg/L	0.02	0.3	0.3			0.23	0.03	1.2	0.07
Magnesium	SW 8010	mg/L	0.01					45	34	50	40
*Manganese	SW 8010	mg/L	0.005	0.05	0.05			0.2	0.43	1.1	0.1
Molybdenum	SW 8010	mg/L	0.2					0.5	0.3	0.2	0.3
Nickel	SW 8010	mg/L	0.04					ND	ND	ND	ND
Potassium	SW 8010	mg/L	0.6					3.4	2.3	0.1	3
Silver	SW 8010	mg/L	0.02	0.05(+)	0.05			ND	ND	ND	ND
Sodium	SW 8010	mg/L	0.1					15	20	43	17
*Zinc	SW 8010	mg/L	0.03	5.0	5.0			0.17	0.07	0.05	ND
Arsenic	SW 7000	mg/L	0.002	0.05	0.05			ND	ND	0.000	ND
Lead	SW 7421	mg/L	0.002	0.05(0.005)	0.05			0.012	ND	ND	0.002
Mercury	SW 7470	mg/L	0.0008	0.002	0.002			ND	ND	ND	ND
1,1,1-Trichloroethane	SW 8010	ug/L	0.5	200.0	200.0			ND	ND	ND	ND
Bromochloroethane	SW 8010	ug/L	0.5	100.0 + 100.0 +				ND	ND	ND	ND
Chloroform	SW 8010	ug/L	0.2	100.0 + 100.0 +				ND	ND	ND	ND
Dibromochloroethane	SW 8010	ug/L	0.5	100.0 + 100.0 +				ND	ND	ND	ND
Freon 113	SW 8010	ug/L	0.5					ND	ND	ND	ND
Methylene chloride	SW 8010	ug/L	2					ND	ND	ND	ND
Trichloroethylene	SW 8010	ug/L	0.5	5.0	5.0			ND	ND	ND	ND
Toluene	SW 8020	ug/L	0.5	(2000.0)				ND	ND	ND	ND
Semivolatiles Organics	SW 8270	ug/L						ND	ND	ND	ND

* = Parameters with secondary maximum contaminant levels for standards.

(a) = Where no values are given, parameter is not regulated.

ND = Not detected.

U = Sample not analyzed for this parameter.

T = Standards listed in parentheses are proposed Federal MCLs with the final rule expected in 1990.

+ = For total trihalomethanes group.

TDS were recorded in all of the perimeter wells, with values ranging from 530 to 710 mg/L. Five of the wells were screened in the shallow water-bearing zone, which had a TDS concentration ranging from 530 to 630 mg/L with a mean of 574 mg/L. In the remaining three wells screened in the deep water-bearing zone, TDS values ranged from 630 to 710 mg/L with a mean of 680 mg/L. The five wells which monitored off-Plant activities had a mean TDS concentration of 620 mg/L, while the three monitoring on-Plant activities had a mean TDS value of 617 mg/L.

A number of metals were detected in the groundwater samples collected from the perimeter wells. Because of the large number of metals and the fact that they are naturally occurring, only those with current or proposed primary MCLs in groundwater will be discussed in Section 4.1.5.3.

4.1.5.2 Sampling or Analytical Problems

One duplicate groundwater sample was taken from 9MW2. The RPDs, measurements of precision, ranged between 0 and 22%, which are within the control limits. Methylene chloride was detected in the trip blank. This is most likely due to laboratory contamination.

The presence of metals detected in the equipment blank collected after sampling well 9MW2 is apparently attributable to the water used to generate this blank. The cadmium, copper, and lead concentrations found in the equipment blank from this sample exceeded their respective primary MCLs. These metals are also found in the two other equipment blanks generated during this sampling effort (wells PG401 and 8MW4).

4.1.5.3 Significance of Findings

Analyte concentrations found in groundwater samples from the perimeter wells were used to compute background levels for comparison with inorganic concentrations at the various sites around the Plant (Table 4-14). Mean chemical concentrations were obtained by adding the concentration values from

each background sample and dividing the total by the number of samples. Since these calculations are for naturally occurring metals, their presence in groundwater is expected; therefore, values for analytes with concentrations below the detection level were computed into the mean at the detection level, rather than zero. In order to more accurately compare chemical concentrations for the various sites with estimated background levels, ranges for acceptable concentrations were established by adding two standard deviations to the mean of each parameter (Table 4-14). The value at the top end of the range is referred to as the high normal background level (HNBL).

Although no primary MCLs have been established for TDS, this analyte warrants discussion due to its high concentrations. All TDS groundwater values detected during the AF Plant 85 Stage 2 investigation of the perimeter wells exceeded the secondary MCL (500 mg/L) established for TDS. Secondary standards are recommended, nonenforceable limits for a public water supply system. Concentrations ranged from 530 to 710 mg/L, with a mean of 614 mg/L, a standard deviation of 65.67, and a HNBL of 745 mg/L. The data suggest that the highest TDS concentrations are found in the outwash underlying the till and that Plant activities are not contributing any more to the high TDS values in the vicinity of the Plant than activities outside the Plant boundaries.

For the purposes of this report, only those metals with established primary MCLs will be discussed and compared to the HNBLs. Aluminum, arsenic, barium, chromium, copper, fluoride, mercury, and selenium concentrations in groundwater samples collected at this site did not exceed their respective MCLs or HNBLs; this medium was not analyzed for the other regulated inorganics (cyanide and nitrate). Although the current MCL for cadmium (0.05 mg/L) was not exceeded, the proposed MCL (0.005 mg/L) was exceeded in two of the perimeter wells. In well 9MW2, located in the northwest corner of the Plant and screened in the till, cadmium was detected at 0.02 mg/L (0.04 mg/L in the field duplicate sample). However, no cadmium was detected in well 9MW1, which is located within 5 feet of well 9MW2 and also monitors the till. In well 9MW6, located in the southwest corner of the Plant and also screened in the till, cadmium was detected at 0.01 mg/L. Although the lead concentration in well 9MW5 (0.012

mg/L) did not exceed the current MCL of 0.05 mg/L, it did exceed the proposed MCL (0.005 mg/L). This well is located on the eastern border of the Plant, is screened in the till, and monitors activities upgradient from the Plant. The copper concentration in well 9MW5 (0.21 mg/L) exceeded its HNBL of 0.17 mg/L, but not its current MCL of 1.0 mg/L.

4.1.5.3.1 Threat to Human Health and Wildlife. TDS values found in groundwater collected from the perimeter wells were above the federal and state secondary MCL, which are recommended, nonenforceable standards for delivery of finished water by a public water supply system. Because these relatively high concentrations of TDS were found Plant-wide in both the till and the outwash, they appear to represent background conditions.

A comparison of the locations of wells 9MW2 and 9MW5 with the map of the potentiometric surface of the shallow wells installed at AF Plant 85 (Figure 2-5) suggests that these wells monitor off-Plant activities. Therefore, the cadmium and lead values in these wells are not likely to be attributable to Plant activities. The only elevated cadmium value which could be attributed to Plant activities was found in well 9MW6; however, this cadmium value is equal to the present MCL (0.01 mg/L) and, because this well is screened in the till, it is unlikely that significant migration of this constituent will occur. The hydraulic conductivity in the till is estimated to be between 10^{-6} and 10^{-8} cm/sec. According to the EPA Hazardous Ranking System, the hydraulic conductivity range for various materials is $>10^{-3}$ to $<10^{-7}$ cm/sec. Also, the till is not used as a drinking water supply, primarily due to the low yield of the water-bearing formation.

The absence of significant contamination in the Plant-wide perimeter wells negates further discussion of contaminant migration or health and environmental threats.

4.2 PRIORITIZATION OF SITES FOR REMEDIAL ALTERNATIVES

Sites studied during the RI/FS, Stage 2 investigation were ranked in order of the severity of contamination as listed below. The ranking system, summarized in Table 4-27, was developed using a variety of information. Indicator chemicals were selected for each site based on both the health hazard of the contaminant and its extent at the site. Each indicator chemical was examined by sample media, noting the number of times the parameter was analyzed, the number of detections of that analyte, the percent of detections, the percent of detections exceeding a standard or criterion, and a multiplier indicating how many times the maximum concentration of the contaminant exceeded the standard or criterion. Then, each contaminant was given a Source Hazard score using a method adapted from the Air Force Defense Priority Model (DPM): $[DPM \text{ Health Hazard score (0 to 9)} \times 9.3] + [DPM \text{ Ecological Hazard score (0 to 6)} \times 2.7] \times \text{Waste Containment Factor (0.1 to 1.0)} = \text{Source Hazard score}$. The DPM was developed for the Air Force by the Oak Ridge National Laboratory (1987) and is similar to the Hazard Ranking System used by EPA. Also used in ranking the sites were observations made at each site, such as the apparent potential for contaminant migration.

4.2.1 PCB Spill Site (Site 3)

As seen in Table 4-27, 21 out of the 31 soil samples collected at Site 3 contained Aroclor 1260. One out of four detections exceeded the federal action level (50 ppm), with a maximum concentration multiplier of 14. The Source Hazard score for PCBs was 76, the highest encountered during the ranking comparisons. Due to the high concentrations found at this site, 40 CFR 761 requires cleanup of the spilled PCBs. The extent of PCB contamination has been defined horizontally with the existing data, but not vertically. Therefore, a field analytical method will need to be utilized during the remedial phase to assure reduction of PCBs to the 25 ppm cleanup level or to whatever level is agreed upon between the Air Force and the regulators during the development of the remediation plan.

Table 4-27. Site Rankings Using Comparisons of Indicator Contaminant Statistics, AF Plant 86

INDICATOR CHEMICALS AT EACH SITE	SOIL SAMPLES										GROUNDWATER SAMPLES			
	NO. ANALYZED FOR PARAMETER	NO. OF DETECTIONS	DETECTIONS (% OF SAMPLES)	DETECTIONS >COL OR AL (%)	MAX. COL OR AL MULT. (X)	NO. ANALYZED FOR PARAMETER	NO. OF DETECTIONS	DETECTIONS (% OF SAMPLES)	DETECTIONS > MCLS (%)	MAX. MCL MULT. (X)				
Site 3:														
Aroclor 1200	31	21	70	24	14	--	--	NA	NA	NA				
Site 4/8:														
TCE	51	4	8	25	30	22	0	0	0	4				4-104
Freon 113	20	0	0	0	0	12	1	8	0*	4				4
Benzo(a)pyrene	20	1	5	100	321	12	0	0	NA	NA				NA
Site 5:														
Benzo(a)pyrene	--	--	NA	NA	NA	4	0	0	NA	NA				NA
Lead	4	4	100	0	<1	6	4	67	50	2				
Site 10:														
Methylene chloride	--	--	NA	NA	NA	--	--	NA	NA	NA				NA
Chromium	--	--	NA	NA	NA	--	--	NA	NA	NA				NA
Perimeter Wells:														
Cadmium	--	--	NA	NA	NA	6	2	25	100	4				
Lead	--	--	NA	NA	NA	6	3	37.5	13	2				

COL = California Designated Levels.

AL = Action levels.

MCL = Maximum Contaminant Levels.

-- = Parameter not analyzed for in this media.

Table 4-27. Site Rankings Using Comparisons of Indicator Contaminant Statistics AF Plant 86
(Continued)

INDICATOR CHEMICALS AT EACH SITE	SURFACE WATER SAMPLES						SEDIMENT SAMPLES			
	NO. ANALYZED FOR PARAMETER	NO. OF DETECTIONS	DETECTIONS (% OF SAMPLES)	DETECTIONS > MCLS (%)	MAX. MCL MULT. (X)	NO. ANALYZED FOR PARAMETER	NO. OF DETECTIONS	DETECTIONS (% OF SAMPLES)	DETECTIONS > LITERATURE GUIDELINES (%)	MAX LIT. GUIDELINE MULT. (X)
Site 3:										
Aroclor 1260	--	--	NA	NA	NA	--	--	NA	NA	NA
Site 4/6:										
TCE	--	--	NA	NA	NA	--	--	NA	NA	NA
Freon 113	--	--	NA	NA	NA	--	--	NA	NA	NA
Benzo(a)pyrene	--	--	NA	NA	NA	--	--	NA	NA	NA
Site 5:										
Benzo(a)pyrene	2	0	0	NA	NA	3	2	67	100	36
Lead	8	6	75	100	4	6	6	100	17	2
Site 10:										
Methylene chloride	2	0	0	NA	NA	2	2	100	NA	NA
Chromium	2	0	0	0	<1	2	2	100	0	<1
Perimeter Wells:										
Cadmium	--	--	NA	NA	NA	--	--	NA	NA	NA
Lead	--	--	NA	NA	NA	--	--	NA	NA	NA

CDL = California Designated Levels.

AL = Action Levels.

MCL = Maximum Contaminant Levels.

-- = Parameter not analyzed for in this media.

NA = Not Applicable.

Table 4-27. Site Rankings Using Comparisons of Indicator Contaminant Statistics AF Plant 85
(Continued)

INDICATOR CHEMICALS AT EACH SITE	DPU HEALTH HAZARD	DPU ECOLOGICAL HAZARD	WASTE CONTAMINANT FACTOR	SOURCE HAZARD SCORE	RANKING	RATIONALE
Site 3:						
Aroclor 1260	7	4	1.0	76	1	21 out of 31 soil samples containing Aroclor 1260 with 1 out of 4 detections exceeding the Federal action level up to 14 times.
Site 4/8:						
TCE	2	1	1.0	21	2	4 out of 51 soil samples containing TCE with 1 detection exceeding a soil criterion by 30 times.
Freon 113	3	0	1.0	28		
Benzo(e)pyrene	3	4	1.0	39		
Site 5:						
Benzo(e)pyrene	3	4	1.0	39	3	2 out of 3 sediment samples both exceeding a sediment criterion for benzo(e)pyrene up to 30 times. 6 out of 8 surface water samples exceed proposed MCL for lead up to 4 times.
Lead	3	4	1.0	39		
Site 10:						
Methylene chloride	1	1	1.0	12	4	No criteria were exceeding by indicator contaminants at site (See Section 4.2.4)
Chromium	4	4	1.0	48		
Perimeter Wells:						
Cadmium	2	0	1.0	35	6	2 out of 8 groundwater samples both containing cadmium exceeding proposed MCL up to 4 times.
Lead	3	4	1.0	39		

CDL = California Designated Levels.

AL = Action levels.

MCL = Maximum Contaminant Levels.

-- = Parameter not analyzed for in this media.

4.2.2 Mason's Run (Site 5)

Table 4-27 shows that benzo(a)pyrene (one of the PAHs) exceeded sediment criteria in two out of three sediment samples, with a maximum concentration multiplier factor of 38 times. The Source Hazard score for benzo(a)pyrene was 39, the third highest score computed during the ranking process. In general, the contaminant problems found in Mason's Run are petroleum-related and are associated with the oil separator/weir system. These are maintenance problems and can be handled on this level, rather than with a full-scale remediation program.

4.2.3 Fire Department Training Area (Site 4) and James Road Hazardous Waste Storage Pad (Site 8)

TCE was detected in four out of 51 soil samples collected from this combined site (Table 4-27). One of the detections exceeded the selected soil criterion by 38 times. Although this one TCE value is considerably higher than the TCE concentration in its duplicate sample, the high value was confirmed in second-column analysis, while the duplicate sample was not. This contaminant was not detected in the water-bearing zone of the Wisconsin till, which is not used as a water supply source in any case. Therefore, it appears that a pathway to receptors is absent. However, the potential for contaminants to enter the groundwater still exists. The one Freon 113 detection in groundwater did not surpass any guidelines, nor was this contaminant detected in surrounding soil samples. Although the one soil sample containing benzo(a)pyrene (PAHs) did exceed the selected criterion by 321 times, it should be recalled that field personnel suspected that the sample was collected from a boring which penetrated an old roadbed; and, PAHs are found in petroleum products and asphalt. Also, no PAHs were detected in any of the groundwater samples collected at this combined site. TCE, Freon 113, and benzo(a)pyrene had Source Hazard scores of 21, 28, and 39, respectively.

It was concluded from evaluating all the available data that this combined site does not present a current threat to human health and the environment.

However, this may not be the case should the property containing the FDTA be sold. Because of the depth at which the high TCE concentration was detected (7.5 to 9.0 feet bgs), excavation of this soil for a building foundation could stir up the TCE, allowing it to enter the atmospheric pathway. A deed disclosure, describing the possibility of TCE on the site, might be required before the Air Force could sell it. This issue, however, is one of legal liability, rather than risk to human health or the environment.

4.2.4 Turkey Run (Site 10)

It may appear from Table 4-27 that Site 10 would rank lower than the perimeter wells, as no criteria were exceeded by indicator contaminants selected for Turkey Run. Although methylene chloride and chromium were chosen as indicator chemicals because their Source Hazard scores (12 and 48, respectively) were higher than the other contaminants, there were other metals found in sediments which exceeded the selected criteria shown in Table 4-22 (such as zinc). Despite the high metals concentrations in sediments collected from Turkey Run, it was determined that this site did not pose threat to human health and the environment. The rationale for this decision is as follows:

1. The metals are apparently bound up in the sediments since concentrations of the same constituents in the surface water are low and do not exceed any primary MCLs, even the more stringent, proposed ones.
2. Although surface waters are the primary source of municipal water supplies in Franklin County, no known supplies are present within 3 miles downstream of the Plant. Although a present threat to human health is not of concern via this pathway, the future use of the larger downstream creeks as a water supply is unknown.
3. Access to the facility is restricted, which eliminates incidental dermal contact with and ingestion of these metals by children and inhalation is highly improbable; therefore, these exposure pathways are not present.
4. According to the Ohio Division of Natural Areas and Preserves, the only endangered or threatened species or critical habitats within 5 miles of the facility are located upstream, to the northeast of Plant 85; therefore,

there is no risk to these environmentally sensitive areas from Plant activities around Turkey Run. Further, Turkey Run flows through a very industrialized setting and a healthy natural stream environment could not be achieved unless more than the Plant's 375-foot segment of this low-flowing stream were involved in cleanup activities.

5. With the possible exception of zinc, there is no significant increase in the concentrations of the metals (used for comparison with guidelines) due to Plant activities. Barium and copper increased in concentrations only slightly.
6. No specific federal or state regulatory standards exist for metals in sediments and the criteria used for comparisons are guidelines only.

4.2.5 Perimeter Wells

Table 4-27 indicates that two of the eight groundwater samples containing cadmium exceeded the proposed primary MCL by up to 4 times; and one lead value exceeded its proposed MCL. However, it should be noted that the monitoring well which contains the highest cadmium level monitors off-Plant activities. The other cadmium value, found in a well monitoring Plant activities, was equal to the proposed MCL and lower than the current MCL. It was determined from available groundwater data gathered from the perimeter wells that Plant activities were not negatively impacting the groundwater exiting the Plant boundaries.

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5.0 ALTERNATIVE REMEDIAL MEASURES

5.1 PRELIMINARY ALTERNATIVE REMEDIAL ACTIONS

The purpose of the three-phase Feasibility Study (FS) process is to develop remedial action alternatives which can achieve acceptable levels of cleanup for specific sites. This phased process begins with the identification of preliminary alternative remedial actions (FS-I); proceeds with the initial screening of alternatives (FS-II); and concludes with a detailed analysis and final screening of the alternatives (FS-III).

The primary purpose of the FS-I is to develop remedial alternatives that protect human health and the environment, encompassing a range of appropriate remediation options. These options range from no action to complete removal and destruction of contaminants. Alternatives for remediation are developed by assembling combinations of techniques into alternatives that address contamination on a site-wide basis. This process consists of six general steps which are listed below:

1. Develop remedial action objectives.
2. Develop general response actions.
3. Identify volumes or areas of media to which the general response actions may apply.
4. Identify and screen the technologies applicable to each general response action.
5. Identify and evaluate technology process options to select a representative process for each technology type retained for consideration.
6. Assemble the selected representative technologies into alternatives that represent a range of treatment options.

Of the six sites investigated at AF Plant 85, only one was chosen for remedial action planning based on its potential threat to human health and the environment. This was Site 3, the PCB Spill Site, where concentrations of PCBs that pose a risk were found.

In January 1983, oil containing PCBs leaked from Transformer P-27 at Electrical Substation 23 located on the Plant grounds (Site 3). The spill area was excavated on two separate occasions but no documentation was found that defined the extent of excavation or the source of fill used at the site. A total of 35 soil samples from 15 boreholes have been collected at the site since the initial excavations. The levels of PCB (Aroclor 1260) found in the soil samples ranged from 0 to 700 mg/kg with the highest concentrations found nearest the substation. Five of the samples near the substation had concentrations ranging from 147 mg/kg to 700 mg/kg. The remaining 30 samples had PCB concentrations ranging from no detection to 24 mg/kg. These concentrations were generally decreasing with depth and distance from the substation. The only medium of interest at this site is the contaminated soil.

5.1.1 Identification of Remedial Action Objectives

The remedial action objectives were developed to protect human health and the environment. The exposure pathways that currently exist at the site are: 1) ingestion or direct contact with the soil, 2) volatilization from the soil into the air where inhalation may occur, and 3) migration into the groundwater which could possibly reach a drinking water supply. The specific remedial action objectives are listed below:

- o Prevent ingestion/direct contact with soils having PCB concentrations in excess of 25 ppm (mg/kg)
- o Prevent inhalation of PCB concentrations in excess of 7.9×10^{-7} mg/m³
- o Prevent migration of PCBs which would result in groundwater concentrations in excess of 8.1 µg/L.

The 8.1 µg/L threshold of PCBs in groundwater is based on the EPA health advisory for the 1-in-a-million incremental cancer risk level. The 7.9×10^{-7} mg/m³ of PCBs is also based on the 1-in-a-million incremental cancer risk level. The 25 mg/kg PCB level in soil is based on the guidance of the Regional EPA to use the 40 CFR 761, PCB spill cleanup policy that has specific requirements for PCB spills at outdoor electrical substations. The remedial

action objectives could all be met by eliminating the PCB source (the contaminated soil).

5.1.2 Identification of General Response Actions

The general response actions were chosen to satisfy the remedial action objectives stated above to varying extents. The response actions chosen are medium-specific to soil and include no action, non-cleanup (including such institutional actions as fencing, deed restrictions, posting, and long-term monitoring), containment, removal, treatment, and disposal. These general response actions are known to be applicable to sites with contaminated soils.

The volume of soil to which the general response actions can be applied is based on the volume of soil with PCB concentrations of 25 mg/kg or greater. The PCB concentrations are known only at discrete points throughout the site. There are also areas where, due to site conditions, the extent of contamination is unknown. These areas include the soil under the concrete pad of the substation and the soil below the concrete conduit that runs beneath the site. Based on the site conditions and known concentrations, a volume that includes a buffer zone around the known soil area contaminated above 25 mg/kg was estimated to ensure that all contaminated soil will be included.

5.1.3 Identification and Screening of Possible Remedial Technologies

The next step in the FS process is to identify and screen the technologies applicable to each of the general response actions to eliminate those that cannot be technically implemented at the site. The general response actions are further defined to specify remedial technology types which apply.

The remedial technologies are broken down further with specific process options selected for each remedial technology. The remedial technologies and process options are then screened, eliminating some technologies and options based on their lack of technical implementability at the site. Implementability is defined as the technical and administrative feasibility to construct, operate, maintain, and obtain approvals and supporting services for

the process option. Screening was performed using information from the RI site characterization on PCB levels and on-site characteristics. The remedial technologies, process options and descriptions, and screening comments can be found on Table 5-1.

The solvent extraction option is not applicable for use with soils and was thus screened out. The photolysis option is generally restricted to use with wastewaters and is not applicable for contaminated soils. PCBs are extremely resistant to oxidation and hydrolysis so these two chemical treatment options were also eliminated. Biodegradation is not applicable because highly chlorinated PCBs such as Aroclor 1260 are very resistant to biodegradation. The molten salt combustion option requires a low ash producing waste so it is not applicable for soils. The multi-hearth incinerator is not capable of combustion at high enough temperatures for the destruction of PCBs and thus it was eliminated from the list of applicable process options. The on-site landfill option was eliminated because the use of the land on AF Plant 85 does not facilitate the construction of a landfill.

Upon completion of the initial screening of technologies and process options, eight process options and one technology were eliminated. The eight remaining technologies and fourteen remaining process options (including no action) will be examined further in the next step of the FS process.

5.1.4 Identification and Evaluation of Technology Process Options

In the fifth step of alternative development the technology process options considered to be implementable are evaluated further to select process options from each remaining remedial technology. This is done to simplify the subsequent development and evaluation of remedial alternatives while still allowing for flexibility by having a range of technologies represented. The process options are evaluated based on relative effectiveness (the extent to which cleanup is achieved), implementability, and cost. In this evaluation the process options are compared only with other process options from the same remedial technology type. The evaluation of process options is illustrated in Table 5-2.

Table 5-1
Initial Screening of Technologies and Process Options

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	SCREENING COMMENTS
NO ACTION	NONE	NOT APPLICABLE	NO ACTION	REQUIRED FOR CONSIDERATION BY MCP
NON CLEANUP ACTION	ACCESS RESTRICTION	FENCING	FENCE PERIMETER OF CONTAMINATED AREA	POTENTIALLY APPLICABLE
CONTAINMENT	CAPPING	MULTI-MEDIA CAP	SURFACE SEAL TO ELIMINATE INFILTRATION AND DIRECT CONTACT	POTENTIALLY APPLICABLE
		SYNTHETIC MEMBRANE	SYNTHETIC SURFACE SEAL TO ELIMINATE INFILTRATION AND DIRECT CONTACT	POTENTIALLY APPLICABLE
REMOVAL	EXCAVATION	SOIL EXCAVATION	REMOVAL OF SURFACE AND SUBSURFACE SOIL	POTENTIALLY APPLICABLE
TREATMENT	PHYSICAL	SOLVENT EXTRACTION	REMOVAL OF CONTAMINANT FROM MEDIUM USING A SOLVENT	NOT APPLICABLE FOR USE WITH SOIL
		SOLIDIFICATION	CEMENT BASED IN-SITU SOLIDIFICATION TO IMMOBILIZE CONTAMINANTS	POTENTIALLY APPLICABLE
		VITRIFICATION	IN-SITU VITRIFICATION MELTS SOIL INTO GLASS IMMOBILIZING AND PYRIMIZING CONTAMINANTS	POTENTIALLY APPLICABLE
		VOLATILIZATION	IN-SITU REMOVAL OF CONTAMINANTS FROM SOIL UTILIZING FORCED/DRAWN AIR CURRENTS	POTENTIALLY APPLICABLE
		PHOTOLYSIS	DECHLORINATION OF PCBs USING SHORTWAVE ULTRA-VIOLET LIGHT	NOT APPLICABLE FOR PCBs IN SOIL
	CHEMICAL	KPER	CHEMICAL PROCESS REDUCING THE TOXICITY OF PCBs	POTENTIALLY APPLICABLE
		OXIDATION	ALTERS THE OXIDATION STATE OF CHEMICALS	PCBs ARE EXTREMELY RESISTANT TO OXIDATION
		HYDROLYSIS	REPLACES CHLORINE ATOMS WITH THE HYDROXYL GROUP	PCBs ARE EXTREMELY RESISTANT TO HYDROLYSIS
	BIOLOGICAL	BIODEGRADATION	DEGRADATION OF ORGANICS USING MICROORGANISMS	HIGHLY CHLORINATED PCBs ARE RESISTANT TO BIODERADATION
	THERMAL	ROTARY KILN	COMBUSTION IN A HORIZONTALLY ROTATING CYLINDER DESIGNED FOR UNIFORM HEAT TRANSFER	POTENTIALLY APPLICABLE
		FLUIDIZED BED	WASTE INJECTED INTO HOT AGITATED BED OF SAND WHERE COMBUSTION OCCURS	POTENTIALLY APPLICABLE
		HIGH TEMP. FLUID WALL	A JACKETED VESSEL USING LARGE ELECTRODES TO SUPPLY HEAT FOR INCINERATION	POTENTIALLY APPLICABLE
		MILTEN SALT COMBUSTION	COMBUSTION OCCURS PRIMARILY IN A BED OF MOLTEN ALKALI METAL SALTS	NOT SUITABLE FOR SOILS (HIGH ASH CONTENT)
		MULTI HEARTH INCINERATOR	INCINERATION UTILIZING A SERIES OF INTERVAL FLAT HEARTHS	NOT SUITABLE FOR HIGH TEMPERATURES
		INFRARED	INFRARED THERMAL RADIATION USED TO DESTROY CONTAMINANTS	POTENTIALLY APPLICABLE
DISPOSAL	LANDFILLING	OFF-SITE LANDFILL	TRANSPORT WASTE OFF-SITE FOR DISPOSAL AT A RCRA APPROVED LANDFILL	POTENTIALLY APPLICABLE
		ON-SITE LANDFILL	CONSTRUCT A LANDFILL ON-SITE THAT COMPLIES WITH RCRA LANDFILL STANDARDS	NOT FEASIBLE WITH PROPOSED FUTURE LAND USE

Table 5-2
Evaluation of Process Options

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST
NO ACTION	NONE	NOT APPLICABLE	• DOES NOT ACHIEVE REMEDIAL ACTION OBJECTIVES	NOT ACCEPTABLE TO LOCAL/PUBLIC GOV'T	NONE
NON-CLEANUP ACTION	ACCESS RESTRICTION	FENCING	• EFFECTIVE IN REDUCING DIRECT CONTACT BUT DOES NOT REDUCE CONTAMINATION	EASILY IMPLEMENTED, RESTRICTS FUTURE LAND USE	LOW CAPITAL, LOW MAINTENANCE
CONTAINMENT	CAPPING	MULTI-MEDIA CAP	• EFFECTIVE IN PREVENTING INFILTRATION AND VOLATILIZATION, HAS SELF HEALING PROPERTIES	EASILY IMPLEMENTED, RESTRICTS FUTURE LAND USE	LOW CAPITAL, LOW MAINTENANCE
		SYNTHETIC MEMBRANE	EFFECTIVE IN PREVENTING INFILTRATION AND VOLATILIZATION, QUESTIONABLE LINER LIFE	EASILY IMPLEMENTED, RESTRICTS FUTURE LAND USE	LOW CAPITAL, LOW MAINTENANCE
REMOVAL	EXCAVATION	SOIL EXCAVATION	• EFFECTIVE IN PERMANENT REMOVAL OF CONTAMINANT	EASILY IMPLEMENTED	LOW CAPITAL
TREATMENT	PHYSICAL	SOLIDIFICATION	• EFFECTIVE IN REDUCING MOBILITY, DOES NOT REDUCE CONTAMINATION	READILY IMPLEMENTABLE	LOW CAPITAL
		VITRIFICATION	EFFECTIVE IN REDUCING MOBILITY WITH SOME CONTAMINANT REDUCTION	NOT IMPLEMENTABLE, UNDERGROUND CABLES IN AREA	HIGH CAPITAL
		VOLATILIZATION	QUESTIONABLE EFFECTIVENESS, VERY SLOW, TREATABILITY STUDY REQ'D	READILY IMPLEMENTABLE	MODERATE CAPITAL, MODERATE TO HIGH O&M
	CHEMICAL	KPEG	• EFFECTIVE IN REDUCING CONTAMINATION, TREATABILITY REQ'D	READILY IMPLEMENTABLE	MODERATE TO HIGH CAPITAL
	THERMAL	ROTARY KILN	• EFFECTIVE AND PROVEN, WIDELY AVAILABLE	READILY IMPLEMENTABLE, MAY REQUIRE SPECIAL PERMIT FOR BURNING PCBs	MODERATE CAPITAL
		FLUIDIZED BED	EFFECTIVE, LIMITED EXPERIENCE WITH PCBs	READILY IMPLEMENTABLE, MAY REQUIRE SPECIAL PERMIT FOR BURNING PCBs	MODERATE CAPITAL
		HIGH TEMP. FLUID WALL	EFFECTIVE, NOT PROVEN AT FULL SCALE	READILY IMPLEMENTABLE, MAY REQUIRE SPECIAL PERMIT FOR BURNING PCBs	MODERATE TO HIGH CAPITAL
		INFRARED	EFFECTIVE, LIMITED EXPERIENCE WITH PCBs	READILY IMPLEMENTABLE, MAY REQUIRE SPECIAL PERMIT FOR BURNING PCBs	MODERATE TO HIGH CAPITAL
	DISPOSAL	LANDFILLING	• EFFECTIVE IN CONTAINING CONTAMINATED SOIL	READILY IMPLEMENTABLE	MODERATE CAPITAL

• = SELECTED REPRESENTATIVE PROCESS OPTIONS



= PROCESS OPTIONS ELIMINATED

The multi-media cap was selected over the synthetic membrane to represent the capping technology. The multi-media cap uses both clay and a synthetic membrane which adds to its effectiveness. The clay layer has regenerative properties which make it more dependable over the long term. A synthetic membrane alone is very effective in preventing infiltration and volatilization but its life expectancy is uncertain. Thus, the combination of the clay and synthetic makes a more effective and dependable cap.

The in-situ solidification option was chosen over vitrification and in-situ volatilization to represent the physical treatment technology. Both in-situ solidification and in-situ vitrification have the same effectiveness in immobilizing the contaminants at the site, but vitrification is considerably more expensive. Also, it would be very difficult to implement this process with the underground conduits running below the site surface. The effectiveness of the in-situ volatilization option in removing PCBs from soil is questionable and a treatability study would be required. This process is also very slow; thus, the in-situ volatilization option was not selected.

Rotary kiln incineration was selected to represent the thermal treatment technology. It is effective and proven in the destruction of PCBs. The fluidized bed, high temperature fluid wall, and infrared options are all potentially applicable for the incineration of PCB contaminated soil, but they have limited or no documented use with PCBs.

5.1.5 Assemblage of Selected Representative Technologies

The final step is to assemble the selected representative technologies into alternatives that represent a range of remediation for the site as a whole. The alternatives selected cover a range of remediation from no action to complete removal, treatment, and disposal. All alternatives address the same volume or area. The soil volume for remediation was estimated to be 60 cubic yards. It was not possible to distinguish between various levels (volumes) of cleanup due to the varied concentrations found, the small area involved, and the unknown concentrations below the concrete pad and conduit. The alternatives selected can be seen in Table 5-3 and are described below.

Table 5-3
Range of Remedial Alternatives

Medium	General Response Action	Remedial Technology	Area or Volume	Alt. 1 No Action	Alt. 2 Perimeter Fencing	Alt. 3 Multi-Media Soil Cap	Alt. 4 In-Situ Solidification/ Chem. Fixation	Alt. 5 Excavation/ KPEG Chem. Treat/ Backfilling/Incin	Alt. 6 Excavation/ Rotary Kfln Incin/Backfilling	Alt. 7 Excavation/ Landfilling/ Backfilling
Soil	No Action	N/A	N/A	X						
Soil	Non Cleanup Action	Access Restriction	Entire Site		X					
Soil	Containment	Capping	All Soil Above 25 mg/kg			X				
Soil	Removal	Excavation	All Soil Above 25 mg/kg					X	X	X
Soil	Treatment	Physical	All Soil Above 25 mg/kg				X			
Soil	Treatment	Chemical	All Soil Above 25 mg/kg					X		
Soil	Treatment	Thermal	All Soil Above 25 mg/kg					X	X	
Soil	Disposal	Landfilling	All Soil Above 25 mg/kg							X

5.1.6 Description of Remedial Alternatives

5.1.6.1 Alternative 1: No Action

The no action alternative would be no action at all. Nothing would be done at the site; it would be left in its present condition.

5.1.6.2 Alternative 2: Perimeter Fencing

The non-cleanup alternative would not include any remedial action that addresses the PCB-contaminated soil. However, it would include the construction of a fence around the perimeter of the site. The fence would prevent access to the site, which would minimize direct contact with the contaminated soil but would also restrict the future land use of the site. The non-cleanup alternative should also include posting the site to warn workers entering the area (e.g., for equipment maintenance) to wear adequate protection.

5.1.6.3 Alternative 3: Multi-Media Soil Cap

This alternative would involve the construction of a multi-media cap which would reduce the flow of water through the site, thereby reducing the contaminant migration from the site. It would also reduce contaminant migration due to volatilization and offer some protection from the release of contaminants that would occur from implementation of a remedial action that would expose the contaminated soil. This alternative would also restrict the future land use of the site.

5.1.6.4 Alternative 4: In-Situ Solidification/Chemical Fixation

This alternative would involve drilling through the PCB-contaminated soil with an expandable-bit drill rig. Fixation chemicals would then be released into the soil and mixed. A series of overlapping columns would be drilled throughout the contaminated soil, forming a solid mass (solidification) and thus reducing the mobility of the contaminants. This would also reduce the potential of exposing the contaminated soil.

5.1.6.5 Alternative 5: Excavation/KPEG Chemical Treatment/Backfilling/Incineration

This alternative would involve excavating the soil containing 25 mg/kg or greater PCBs, treating it on site using the KPEG (potassium polyethylene glycol) process, which destroys the PCBs by dechlorination, and returning it to the site of excavation since it is assumed that the treated soil would no longer be considered a hazardous waste. This assumption would have to be confirmed through laboratory analysis. The KPEG process would reduce the toxicity of the soil, but it would produce a volume of waste that must be treated as wastewater. The residuals created by the KPEG process are commonly treated by chemical oxidation, biodegradation, carbon adsorption, or incineration. This alternative would satisfy the remedial objectives by removing and treating the contaminants.

5.1.6.6 Alternative 6: Excavation/Rotary Kiln Incineration/Backfilling

Alternative 6 would involve excavating the soil containing 25 mg/kg or greater PCBs and transporting it off site to a facility for incineration in a rotary kiln and disposal of the ash. The excavated material would be replaced with clean fill. This alternative would satisfy the remedial objectives by completely removing and destroying the contaminants in the soil.

5.1.6.7 Alternative 7: Excavation/Landfilling/Backfilling

This alternative would involve the excavation of all soil with PCB levels at or above 25 mg/kg and transporting it to a RCRA-approved hazardous waste landfill. The excavated soil would be replaced with clean fill. Although the contaminated soil would be completely removed from the site, it would merely be placed in a landfill without any treatment. This alternative would meet the remedial objectives at the site.

5.2 INITIAL SCREENING OF ALTERNATIVES

The second phase of the feasibility study process involves the screening of alternatives developed during the first phase of the FS to narrow the list of potential alternatives to be evaluated in detail. Three distinct steps are usually conducted during the screening of alternatives. First, the alternatives are evaluated to determine their effectiveness for protection of public health and the environment. Second, the alternatives are evaluated to determine their technical feasibility. Finally, the alternatives are costed to achieve an accuracy within +100% to -50%.

The PCB Spill Site remedial action alternatives to be screened in this section include No Action, Perimeter Fencing, Multi-Media Soil Cap, Excavation/Landfilling/Backfilling, In-Situ Solidification/Chemical Fixation, Excavation/KPEG Chemical Treatment/Backfilling/Incineration, and Excavation/Rotary Kiln Incineration/Backfilling. The remedial action objectives that these alternatives attempt to meet are listed below:

- o Prevent ingestion/direct contact with soils having PCB concentrations in excess of 25 mg/kg
- o Prevent inhalation of PCBs in concentrations in excess of 7.9×10^{-7} mg/m³
- o Prevent migration of PCBs which would result in groundwater concentrations in excess of 8.1 µg/L.

5.2.1 Alternative 1: No Action

The no action alternative would have no effect on the potential risks present at the PCB Spill Site. It would provide no protection to the environment or human health and there would be no reduction in the toxicity, mobility, or volume of the contaminants. There would be no additional threat to human health and the environment caused by the no action alternative. The threat of human exposure and further contaminant migration into the environment would remain.

Although the no action alternative would have no impact on the site, it is retained in the FS process as a baseline against which other remedial alternatives can be compared.

5.2.2 Alternative 2: Perimeter Fencing

This alternative would include the construction of a fence around the perimeter of the contaminated soil with signs posted on the fence stating that the area is contaminated with PCBs. The fencing alternative would limit access to the contaminated area.

5.2.2.1 Human Health and Environmental Impacts

The short-term effectiveness of fencing the perimeter of the contaminated soil would be a reduction of the potential for direct human contact. There would be no protection to the environment provided by fencing the area. There would be no additional threat to human health or the environment by installing a fence, but the potential for inhalation and ingestion/direct contact would still exist. The time required for installation would be minimal (less than one week).

The long-term effectiveness of this non-cleanup alternative would be minimal. The risk present at the site would remain. The possibility of further PCB migration both vertically and horizontally within the soil would still be present. There would be a sole reliance on the fence to prevent access while retaining the possibility of migration beyond the fence. There would be no reduction in toxicity, mobility, or volume since treatment or removal would not be employed.

5.2.2.2 Technical Feasibility

The perimeter fencing alternative would not include any remedial action that addresses the PCB-contaminated soil. It would include the construction of a 6-foot high chain linked fence with three strands of barbed wire on top. The fence would enclose the site, approximately 15 by 20 feet, and would have

a single walk-through gate that would remain locked at all times. Signs would be posted on the fence stating that the area is contaminated with PCBs.

Size and configuration. The non-cleanup alternative would cover the entire site. This alternative would involve fencing the perimeter of the site and buffer zone which is approximately 15 by 20 feet.

Time frame. The time required for installing a fence would be minimal (less than one week).

Spatial requirement. Negligible.

Implementability evaluation. A fence would be easily constructed. Services and materials for fencing would be readily and locally available.

5.2.2.3 Cost Evaluation

The estimated cost of a 6-foot chain link fence topped with 3 strands of barbed wire and one walk-through gate would be \$1,000, installed (from Aspen Fence Co., Denver).

5.2.3 Alternative 3: Multi-Media Soil Cap

The Multi-Media Soil Cap alternative would reduce infiltration, contaminant migration, volatilization, and access to the PCBs. The cap would consist of a low-permeability soil layer covered by a synthetic membrane which would be covered by a layer of sand, followed by a layer of topsoil. The cap would cover the entire area of contamination.

5.2.3.1 Human Health and Environmental Impacts

The short-term effectiveness of a multi-media cap would be reduced because of the amount of time required for design and construction. There would be an increase of dust during construction, but the contaminated soil would remain largely undisturbed. There are no significant adverse environmental impacts from the construction of a multi-media cap.

A multi-media cap would reduce the potential for direct contact with the PCB-contaminated soil and it would reduce leaching. Capping is a well established, proven technology. The cap would require regular inspection and maintenance; and the risk from contact with the soil would still exist should the cap fail. Although leaching would be reduced, there would still be the potential for vertical and horizontal migration beyond the boundaries of the cap. Capping would reduce the mobility of the PCBs but would offer no reduction of toxicity or volume.

The physical nature of the multi-media cap would impede the exposure pathways at the site and provide good risk reduction. However, since the PCBs would remain at the site, there would be a potential risk if the cap failed.

5.2.3.2 Technical Feasibility

The containment alternative would involve the construction of a multi-media cap to cover the site and buffer zone, which is approximately 15 by 20 feet in size. The cap should consist of a low-permeability layer ($\leq 1 \times 10^{-7}$ cm/s) at least two feet thick, covered by a synthetic liner, covered by a high-permeability drainage layer ($\geq 1 \times 10^{-3}$ cm/s) at least one foot thick, covered by a top soil layer at least two feet thick, with an appropriate vegetative layer covering the top soil (Handbook: Remedial Action at Waste Disposal Sites, USEPA, 1985). The cap should have a minimum slope of 2% for proper drainage. The property deed would be changed to restrict access and use of the capped area.

Size and configuration. The area to be capped would be approximately 15 by 20 feet. The cap should be approximately 5 to 6 feet thick. An area surrounding the 15 by 20-foot capped area would be required to allow for a gentle grade from the edge of the cap down to the natural ground elevation.

Time frame. The time for installation of a multi-layer cap would be minimal (approximately one week). The time required for the design and design approval could be substantial.

Spatial requirement. The area required for cap construction would be approximately three times the area of the site. This area would be needed for parking equipment and staging cap materials.

Implementability. A multi-media cap is a well established technology and normally is easily implemented. This site is located next to an electrical substation and it has power lines running through the contaminated soil. It is possible that these lines would need to be accessed in the future, which means the cap would have to be destroyed to access the power lines. If the power lines were moved prior to capping, it would involve excavation. This would eliminate the major advantage of containment with a multi-media cap, which is not having to disturb the contaminated soil. There would also be a problem with grading from the edge of the cap down to the natural ground elevation. The cap would be required to at least go to the edge of the substation and it would not be possible to properly finish the edge of the cap.

Based on the implementability problems of a multi-media cap, this alternative would not be studied further unless information eliminating these problems is found.

5.2.4 Alternative 4: In-situ Solidification/Chemical Fixation

This alternative would involve the in-situ mixing of a fixation chemical with the PCB-contaminated soil to form a solid mass. An expandable-bit drill would be used for mixing and, by drilling a series of overlapping columns, the area would be solidified. The PCBs would be chemically fixed in the soil, thus greatly reducing their mobility. This would prevent any further migration, volatilization, and contact with the contaminated soil.

5.2.4.1 Human Health and Environmental Impacts

The immobilization alternative could be effective in reducing the mobility of the PCB-contaminated soil in about two weeks. There may be a slight increase in dust during the mixing process but during previous operations at a similar site, no PCBs were detected in the air (D. Miller, pers. com., 1989).

Protection for workers would be required to prevent dermal contact and inhalation of contaminants during operations. The in-situ solidification alternative would not cause any significant adverse environmental impacts.

After the fixation process was completed, the PCBs would be chemically bonded to the solidified soil. This would reduce the risk of migration through the soil and into the groundwater and prevent any volatilization or dust particles from reaching the atmosphere. The PCBs, however, would still be present at the site.

The in-situ fixation process is a new process which has just recently been tested by the US EPA under the SITE Program at a similar site. It appears from these tests that the fixation is complete (Stinson, pers. com., 1989). Since the process is new, there has been no testing of the long-term stability of the solidified soil. Continued monitoring would be required to ensure that PCBs are not leaching from the solidified mass.

The immobilization alternative would not reduce the toxicity or volume of the contaminated soil but would only immobilize the contaminants.

5.2.4.2 Technical Feasibility

This immobilization alternative would involve the use of International Waste Technology (IWT) in-situ stabilization/solidification process, which uses IWT additives to generate a complex crystalline, connective network of inorganic polymers that chemically fix the PCBs. These additives would be mixed into the contaminated soil using the Geo-Con Deep Soil Mixing system. This mechanical mixing system would consist of a 36-inch diameter drilling auger containing one set of cutting blades and two sets of mixing blades attached to a vertical drive shaft. The additive slurry and supplemental water would be injected through the bottom of the auger into the zone being agitated by the rotating blades. The auger assembly would be supported and powered using a crane. A batch mixing plant for the slurry consisting of storage silos, mixing tank, a compressor, and pumps would also be required. The auger assembly would be used to mix and solidify a series of overlapping columns until the entire site had been treated.

The PCBs would be complexed initially in a fast-acting first phase reaction and permanently complexed further in the building of macromolecules, which would take about four weeks.

Size and configuration. The equipment involved in the in-situ solidification process would include a crane, two storage bins, mixing tank, an air compressor, and some pumps. The crane would be set up at the site and would require an operating area of approximately 1,000 ft² around the site. The treatment slurry prep and feed system would require an area of approximately 750 ft², which would need to be located near the site.

Time frame. The time for mobilization, process set up, and soil treatment would take a maximum of two weeks, with one additional week required for demobilization. Two weeks for a bench scale test would also be required.

Rates or flows of treatment. Approximately 200 ft³/hr or 7.4 yd³/hr could be treated.

Implementability. The in-situ fixation process is a new technology in the remediation field. Its limited use appears to be effective in immobilizing PCBs in contaminated soil. The specialized equipment and operations are available for use. A major problem with the implementation of the in-situ fixation process is the presence of the concrete conduit running through the site and the lack of information known about its location and the possible presence and location of additional conduits. The extent of contamination under these conduits and also under the concrete pad of the electrical substation is unknown. The fixation process would not be able to treat these areas of contamination without destroying the conduits and the pad. The fixation auger could possibly be angled at 10 to 15° which would allow for some penetration beneath the pad and the conduits. Geo-Con (D. Miller, pers. com., 1989) has also suggested that jet grouting could be used to inject grout into the soil below the pad and conduits.

Even if the areas below the concrete pad and conduits can be treated, there still remains some major implementability problems. The vertical extent

of contamination is unknown at the site, so the depth to which treatment would be required is also unknown. Therefore, additional sampling would be needed prior to implementation of this alternative. The biggest problem with this alternative, however, is that implementation would render the conduits inaccessible, encased in the solidified mass. It is probable that the lines running through the conduits would need to be accessed in the future, which would not be possible if they were encased in the solidified soil.

Based on the implementability problems of this alternative, the In-Situ Solidification/Chemical Fixation process will not be studied further unless information eliminating these problems is found.

5.2.5 Alternative 5: Excavation/KPEG Chemical Treatment/Backfilling/Incineration

Alternative 5 would involve the excavation of soil containing 25 mg/kg or greater PCBs. The extent of excavation would be determined by using a field analytical method which would measure the PCB concentrations in samples collected during the excavation. The excavated soil would be treated using the KPEG process and then replaced into the excavated area. The liquid waste produced by the KPEG process would be incinerated. This alternative would treat the PCB-contaminated soil to reduce concentrations in the soil to an acceptable level. The PCBs would be chemically altered and then destroyed. Although the KPEG process is a new process that has had limited use, bench scale and pilot scale studies have shown it to be effective in removing PCBs from soils.

5.2.5.1 Human Health and Environmental Impacts

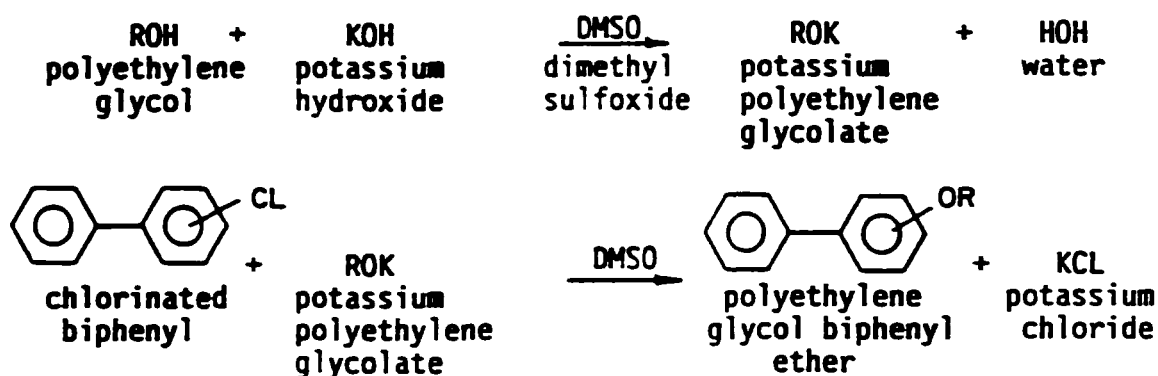
The chemical treatment alternative can be effective in removing the PCBs from the contaminated soil and reducing their toxicity. The chemical treatment process can be applied in a period of approximately one month. There would be an increase in dust during excavation and the chemical process would produce a liquid waste. The liquid waste produced would be transported to an incinerator for disposal. Workers would require protection from dermal contact

and inhalation of contaminants during excavation and processing. There should be no significant adverse environmental impacts from the excavation and treatment process. There could be a possibility of a chemical spill while handling the reagents for the treatment process.

After completing chemical treatment, the PCB soil concentrations would be greatly reduced (<10 ppm in the treated soil) and consequently the risks at the site would also be greatly reduced. However, before the treated soil would be replaced into the excavated area, soil analysis would be required to confirm the PCB removal. Once the PCBs were removed from the site, there would be no need for any further controls at the site. The PCBs would be converted to polyethyleneglycol biphenyl ethers and then incinerated. Thus, a significant reduction in the volume, mobility, and toxicity of the contaminant would be achieved.

5.2.5.2 Technical Feasibility

The KPEG process is a chemical treatment technology for PCB-contaminated soils. The chemical reagents used in the process are potassium hydroxide (KOH) and polyethylene glycol (PEG). A sulfoxide, usually dimethyl sulfoxide (DMSO), is used as a catalyst to increase the overall rate of reaction. The KPEG chemical reactions are shown below:



In KPEG soils processing, the soil and the reagent are mixed to form a slurry. The slurry is then heated to approximately 150°C with mixing continued until the PCBs are decomposed to water soluble materials with a lower toxicity. At the end of the reaction, the reagent is recovered by filtration and soil washing. The treated soil is then discharged and the reagent and wash waters are recycled. The reaction system is closed to prevent the release of materials into the environment.

The overall KPEG process includes reagent preparation, soil preparation, physical mixing of soil with reagent, thermochemical reaction of reagent with PCBs in soil, soil/reagent separation, soil washing with water, and reagent recovery. The equipment involved in this process includes a reagent feed drum, a steam generator, a steam jacketed Littleford reactor mixer, a reagent recycle drum, three wash drums, two condensate drums, an ice water condenser, and a Nixtox sorbent drum. The pilot scale KPEG process equipment would be applicable to the quantity of soil requiring treatment at this site (Milicic, pers. com., 1989).

Size and configuration. The chemical treatment alternative would involve the excavation of contaminated soil and the chemical processing of the soil. The clean soil would then be replaced into the excavated area. The area to be excavated is approximately 10 by 12.5 feet with a maximum depth of 10 feet. Excavation would be complicated by concrete conduits containing power lines that run through the site. The chemical process would require an area of approximately 75 by 75 feet and would be located near the site. The process would require a temporary shelter to protect it from the weather.

Time frame. The time for treatment, excavation, and process setup should take a maximum of approximately one month.

Spatial requirements. Excavation would require an area large enough for the parking and operation of the excavation equipment. The area required for the KPEG process would be approximately 75 by 75 feet.

Implementability. The KPEG chemical treatment process is a relatively new process for treating PCB-contaminated soils, but it should be easy to implement. However, a treatability study would be required prior to implementation to confirm the process effectiveness on the site-specific soils. The process equipment used for the pilot scale study would be adequate to handle the quantity of soil at this site (Milicic, pers. com., 1989). The excavation required at the site would be complicated by the presence of three concrete conduits running through the site and by the concrete pad of the substation which covers some of the contaminated soil. These complications should only slightly increase the time for excavation. Testing the treated soil before replacing it at the site would also add to the time required to complete remediation, but it would not be an implementation problem. The disposal of the liquid waste created from the treatment process would be handled by the process operators who have experience dealing with these wastes. Overall, there appear to be no major implementation problems associated with the KPEG process.

5.2.5.3 Cost Evaluation

A cost of \$183,100 was estimated for the implementation of the Excavation/KPEG Chemical Treatment/Backfilling/Incineration alternative on 60 cubic yards of contaminated soil. This estimate was based on information from the Air Force IRP Pricing Guide (HMTG, 1986) and from the Galson Remediation Corporation (Milicic, pers. com., 1989). These costs include regional cost factors and health and safety factors where appropriate. The breakdown of the cost is as follows:

Excavation	\$ 1,800
Treatment and Waste Handling	180,000
Backfilling	<u>1,300</u>
Total	\$183,100

5.2.6 Alternative 6: Excavation/Rotary Kiln Incineration/Backfilling

This alternative would include the excavation of soil with PCB concentrations greater than 25 mg/kg, the incineration of the excavated soil, and backfilling the excavated area with clean fill. The extent of excavation would

be determined by using a field analytical method to measure PCB concentrations in samples collected during excavation. The contaminated soil at the site would be removed and the PCBs destroyed in a rotary kiln incinerator. The excavated area would then be backfilled with clean fill dirt.

5.2.6.1 Human Health and Environmental Impacts

The thermal treatment alternative involves the excavation and removal of PCB-contaminated soil to a federally approved incinerator. The short period of time required for excavation and removal (approximately one week) means that this alternative can be effective quickly. The risk at the site would be significantly reduced once the excavation and removal have been completed. There would be an increase in dust from the PCB-contaminated soil during excavation and staging. Workers would require protection from inhalation and dermal contact with the contaminated soil. A federally approved incinerator would be used so air quality impacts would be minimized by the use of an emissions control system. There should be no significant adverse environmental impacts from the incineration alternative.

After the soils had been removed and incinerated, the PCB concentrations at the site would be reduced to less than 25 ppm. The risk at the site would be reduced to an acceptable level and there would be no need for any future controls at the site. Incineration is a proven and reliable technology for destroying PCBs. No long-term treatment or management of the residuals would be required. The toxicity of the PCB-contaminated soil would be eliminated; thus, the volume and mobility of waste would also be eliminated. The ash from the incinerator, however, would still be considered hazardous and would be handled by incinerator operators. The incineration alternative would be a permanent and ultimate solution.

5.2.6.2 Technical Feasibility

This alternative first would involve the excavation of the contaminated soil and its transportation off site to an approved incineration facility. The excavation would be conducted using a backhoe for the majority of removal,

the PCB-contaminated soil be put in barrels prior to incineration. The distance to an incinerator and barrelling could make implementation of thermal treatment more difficult.

5.2.6.3 Cost Evaluation

A cost of \$292,100 was estimated for the implementation of the Excavation/Rotary Kiln Incineration/Backfilling alternative. This cost estimate is based on information from the Air Force IRP Pricing Guide (HMTG, 1986) and from the Ensco Incinerator facility in Eldorado, Arkansas (Eckart, pers. com., 1989). These costs include regional cost factors and health and safety cost factors, where appropriate. The breakdown of the cost is as follows:

Excavation	\$ 1,800
Transportation	22,000
Incineration and Ash Handling	267,000
Backfilling	<u>1,300</u>
Total	\$292,100

5.2.7 Alternative 7: Excavation/Landfilling/Backfilling

This alternative would include the excavation of soil with PCB concentrations greater than 25 mg/kg, the disposal of the soil in a landfill, and the backfilling of the area with clean fill. The extent of excavation would be determined by using a field analytical method to measure PCB concentrations in samples collected during excavation. The contaminated soil would be removed from the site, thus reducing the on-site risk to acceptable levels. The PCBs, however, would not be destroyed; the risk would be transferred to the landfill where they would be stored.

5.2.7.1 Human Health and Environmental Impacts

The removal alternative can be very effective in a short period of time. Excavation and removal can be completed in a week and all risks from the site would be eliminated. There would be an increase in dust from the contami-

The excavation would be conducted using a backhoe for the majority of removal, but some hand excavation would also be required. There are conduits running through the area to be excavated (approximately 10 feet by 12.5 feet by 10 feet deep) that would complicate the operation. Some excavation under the concrete pad of the electrical substation could also be required, possibly involving shoring up these structures for support until the excavated area was filled with clean fill dirt. The contaminated soil would have to be drummed prior to transportation to the nearest federally approved incineration facility, which does not accept bulk waste. This facility, in Eldorado, Arkansas, uses a rotary kiln for incineration.

Size and configuration. The actual incineration would take place at an off-site location, the area involved would be that required for excavation. The area to be excavated would be approximately 10 by 12.5 feet with a maximum depth of 10 feet. Excavation would be implemented using a backhoe and some hand excavation. The excavation would be complicated by conduits containing powerlines that run through the site. The excavated soil would be transported to an incineration facility that meets the requirements of 40 CFR Part 761.70.

Time frame. The time frame for excavation and incineration is minimal (approximately one week).

Spatial requirements. The spatial requirements would be the same as for excavation. The area required would be that used to park excavation and hauling equipment.

Implementability. Excavation and incineration are commonly used for treatment of PCB-contaminated soil. There are several contractors in Ohio who handle PCB excavation and transportation. The excavation would be complicated by the presence of conduits that run through the site and by the concrete pad of the substation which covers some of the contaminated soil. These complications should only slightly increase the time for excavation. The incineration of PCB-contaminated soil would require special equipment. The distance to the nearest federally approved incinerator that handles PCB-contaminated soil is unknown at this time. It is also normally required that

nated soil during the excavation and staging period. Protection for workers would be required to prevent dermal contact and inhalation of contaminated dust during excavation. The removal alternative would not cause any significant adverse environmental impacts.

After excavation was completed, the soil would contain less than 25 ppm PCBs. The risk would be permanently reduced and there would be no need for any controls at the site. The PCB-contaminated soil would be transported and disposed of in a federally approved PCB landfill. Landfilling is a proven technology and the likelihood of failure would be small at an approved landfill. At the site, the toxicity, mobility, and volume of contaminated soil would be eliminated. However, on the whole, there would be no reduction in toxicity or volume. The mobility would be reduced by proper landfilling.

5.2.7.2 Technical Feasibility

The removal alternative would involve the excavation of the contaminated soil and its transportation off site to a federally approved landfill for disposal. The excavation would be conducted using a backhoe for the majority of the excavation with the remainder done by hand. The area to be excavated is approximately 10 by 12.5 feet with a maximum depth of 10 feet. There are conduits running through the site that would complicate the excavation. Some excavation under the concrete pad of the electrical substation would also be required. Shorings could be required to support the conduits and edge of the concrete pad until the excavated soil was replaced with clean fill. The soil would be hauled in covered semi-dump trailers to the nearest TSCA-approved landfill in Emelle, Alabama for proper disposal.

Size and configuration. The area to be excavated is approximately 10 by 12.5 feet. The maximum depth of excavation is 10 feet. Excavation would be implemented using a backhoe and some hand excavation. The excavation would be complicated by conduits containing powerlines that run through the site. The excavated soil would be transported and landfilled at a landfill meeting the requirements of 40 CFR Part 761.75.

Time frame. The time frame to complete excavation would be minimal (approximately one week).

Spatial requirements. The spatial requirements for excavation would be small. The only area required would be that to park excavating and hauling equipment.

Required permits and imposed limitations. The contractor would need to have all the required permits for excavation, transportation, and landfilling of PCB-contaminated soils.

Implementability. Excavation and landfilling are widely used technologies and there are several contractors in Ohio that handle PCB excavation and disposal. It is a proven and reliable technology for cleaning up PCB spill sites. The excavation would be complicated by the presence of conduits running through the site and the concrete pad of the substation which covers some of the contaminated soil. This complication should only slightly increase the time for excavation. The location of a federally approved PCB landfill would add more to the cost of the removal alternative than it would to the difficulty of implementation. Overall, the removal alternative could be easily implemented.

5.2.7.3 Cost Evaluation

A cost of \$44,100 was estimated for the implementation of the Excavation/Landfilling/Backfilling alternative. This cost estimate is based on information from the Air Force IRP Pricing Guide (HMTG, 1986). These costs include regional cost factors and health and safety cost factors, where appropriate. The breakdown of the cost is as follows:

Excavation	\$ 1,800
Transportation	17,000
Disposal in Landfill	24,000
Backfilling	<u>1,300</u>
Total	\$ 44,100

5.2.8 Conclusions

From the information gathered during the screening process, the Multi-Media Soil Cap alternative and the In-Situ Solidification/Chemical Fixation alternative were both found to be infeasible. The physical requirements for finishing the edge of a cap cannot be met with the electrical substation bordering the contaminated area. Both the capping and solidification alternatives would make it impossible to access the conduits running through the site without destroying either the cap or the integrity of the solidified mass. Based on these implementability problems, discussion of these two alternatives will not be continued in the detailed analysis phase of the FS process.

The alternatives screened in the FS II phase are compared in Table 5-4. The alternatives remaining for the detailed analysis include No Action, Perimeter Fencing, Excavation/KPEG Chemical Treatment/Incineration, Excavation/Rotary Kiln Incineration/Backfilling, and Excavation/Landfilling/Backfilling. These remaining alternatives all appear feasible, while still covering a range of actions and degrees of remediation.

5.3 DETAILED ANALYSIS OF ALTERNATIVES

A detailed analysis will be performed for the following remedial alternatives at the PCB site:

- o No Action
- o Perimeter Fencing
- o Excavation/KPEG Chemical Treatment/Backfilling/Incineration
- o Excavation/Rotary Kiln Incineration/Backfilling
- o Excavation/Landfilling/Backfilling.

The detailed analysis will include a technical analysis, environmental analysis, public health analysis, institutional analysis, and a cost analysis for each alternative. The alternatives will then be compared for present worth costs, health information, environmental effects, technical aspects, how well

Table 5-4
Alternative Screening Summary

Remedial Alternative	Level of Reduction		Risk Reduction	Technical Feasibility	Estimated Cost	Comments
	Mobility	Toxicity Volume				
No Action	None	None	None	NA	NA	The no action alternative is retained as a baseline against which other alternatives are compared.
Perimeter Fencing	None	None	Low	Good	\$1,000	Limits access to site, inexpensive, easily implemented.
* Multi-Media Soil Cap	Mod-High	None	Mod	Poor	NA	Eliminated due to its poor technical feasibility.
* In-Situ Solidification/ Chemical Fixation	High	None	Mod-High	Poor	NA	Eliminated due to its poor technical feasibility.
Excavation/KPEQ Chemical Treatment/ Backfilling/Incineration	High	High	High	Good	\$183,100	Removes PCBs from site, destroys PCBs, high risk reduction, requires treatability study.
Excavation/Rotary Kiln Incineration/Backfilling	High	High	High	Good	\$292,100	Removes PCBs from site, destroys PCBs, high risk reduction.
Excavation/Landfilling/ Backfilling	Mod-High	None	High (at site)	Good	\$44,100	Removes PCBs from site, high risk reduction at site but creates risk at landfill.

* = Alternatives that were eliminated during the screening process

the alternatives meet technical requirements and environmental regulations, community effects, and any other pertinent factors that may affect implementability or influence which alternative is selected.

5.3.1 Detailed Analysis of the No Action Alternative

The no action alternative remains in the FS process to serve as a baseline against which the other alternatives can be compared.

5.3.1.1 Technical Analysis for the No Action Alternative

A technical analysis for the no action alternative is not applicable.

5.3.1.2 Environmental Analysis for the No Action Alternative

Under the no action alternative the site would remain in its current state. Concentrations of PCBs as high as 700 mg/kg were found near Substation 23. The source of the PCBs at Site 3 was the result of a "one-time" spill from a leaking valve on a transformer at the substation, in January 1983. The quantity of contaminants at the site should not increase any further. There are approximately 60 cubic yards of contaminated soil at the site but the quantity of soil with PCB concentrations above 25 mg/kg is not completely defined.

PCBs are very persistent in the environment and have a high affinity for soils. The two potential exposure pathways at the site are the inhalation of dust particles containing PCBs and dermal exposure by direct contact with the contaminated soil. If no action were taken at the site, these two exposure pathways would remain. PCBs have low water solubility, high affinity for soils, and resistance to biodegradation, which make natural dispersion of the contaminants very slow.

5.3.1.3 Public Health Analysis for the No Action Alternative

The contaminant found at AF Plant 85 Site 3 is the PCB Aroclor 1260. A total of 35 soil samples were collected from the site and the PCB concentra-

tions ranged from no detection to 700 mg/kg. Five of the samples near the substation had concentrations ranging from 147 mg/kg to 700 mg/kg. The remaining 30 samples ranged from no detection to 24 mg/kg, with eight samples being no detection.

PCBs are very persistent in the environment and they have a high affinity for soils and low water solubility. The EPA weight-of-evidence category for PCBs is Group B2, a probable human carcinogen, indicating that there is sufficient evidence of carcinogenicity in animals, with inadequate evidence of carcinogenicity in humans (SPHEM, 1986). In humans exposed to PCBs, reported adverse effects include chloracne, impairment of liver function, a variety of neurobehavioral and affective symptoms, menstrual disorders, minor birth abnormalities, and probably increased incidence of cancer (Clement Associates, 1985).

The potential exposure routes on site include inhalation of PCB-contaminated dust and dermal exposure by direct contact with the soil. The contaminated area is well within Plant boundaries so its access is restricted. This limits the potentially affected population to the Plant personnel working on or near the contaminated area.

The inhalation exposure route and dermal contact exposure route would be present at Site 3 under the no action alternative. The PCB concentrations at the site present health risks to the exposed population. The acceptable PCB dose for short-term exposure for a 70 kg person that represents a 10^{-6} cancer risk is 0.0133 mg/day (AGWSE, 1989). At a PCB concentration of 700 mg/kg in the soil, a person ingesting and/or inhaling 19 mg/day of the soil would be at the acceptable level. Any amount greater than this would put the person at a 10^{-6} cancer risk. The acceptable dose for long-term exposure at a 10^{-6} cancer risk is 1.61×10^{-5} mg/day (AGWSE, 1989). At a PCB concentration of 700 mg/kg in the soil, a 70 kg person inhaling and/or ingesting 0.023 mg/day over their lifetime will be at a 10^{-6} cancer risk. Ingestion of soil has not been discussed as an exposure pathway because it is usually considered to apply only to small children; however, under certain working conditions, it could apply to the exposed population at Plant 85.

5.3.1.4 Institutional Analysis for the No Action Alternative

No Permits would be required with the no action alternative.

5.3.1.5 Cost Analysis for the No Action Alternative

There would be no costs associated with the no action alternative.

5.3.2 Detailed Analysis of the Perimeter Fencing Alternative

5.3.2.1 Technical Analysis of the Perimeter Fencing Alternative

5.3.2.1.1 Performance Appraisal. The non-cleanup action alternative would be effective in limiting the access to the area contaminated by the PCBs. It would also be effective in warning those that must enter the contaminated area that they should acquire the appropriate safety equipment prior to entering the area.

5.3.2.1.2 Compliance with ARARs. The fencing alternative would not comply with the ARAR requiring the cleanup of PCB-contaminated soil to a concentration of less than 25 mg/kg. The non-cleanup alternative would not attempt to reduce the toxicity, mobility, or volume of contaminants at this site.

5.3.2.1.3 Site/Waste Conditions. There would be no special site or waste conditions that would affect the ability of the fence to prevent access to the site. The fence should require minimal to no maintenance.

5.3.2.1.4 Alternative Results. This alternative would not reduce the toxicity, mobility, or volume of contaminated soil and thus the potential would exist for continued migration of the PCBs throughout the soil in the area of the electrical substation.

5.3.2.1.5 Health and Safety Requirements. The safety requirements for the installation of the fence would include practices to minimize dust

production and the inhalation of dust particles by workers. PCBs have a strong adherence to soil so dust masks or respirators should be adequate protection for workers installing the fence.

5.3.2.2 Environmental Analysis for the Perimeter Fencing Alternative

The non-cleanup alternative would not address the PCB-contaminated soil with any type of remedial measure; thus, it would not provide any protection for the environment. The non-cleanup alternative would provide minimal short-term protection to public health and welfare by limiting access to the area and making the public aware of the problem.

The only pathway of contamination addressed by the fencing alternative would be the direct contact pathway, which would be the major pathway of concern. Fencing the perimeter of the contaminated area would only be a temporary obstruction of the pathway, since the PCBs could eventually migrate beyond the fence. The other pathway of concern, the inhalation of PCB-contaminated dust particles or vapors, would not be addressed by the non-cleanup alternative.

Although the perimeter fencing alternative would not address the PCB-contaminated soil directly, it still would have some beneficial effects at the site. The most beneficial effects would be limiting access to the contaminated area and posting the area to make the public aware of the problem so that, if access to the area is required, the proper protective measures could be taken. Implementing the fencing alternative would not create any additional adverse effects at the site.

All risks at the site would remain under the fencing alternative. The PCBs at the site would continue to slowly migrate both vertically and horizontally in the soil. The potential for release into the atmosphere would also continue at the site. The direct contact and inhalation exposure pathways would still be present. The non-cleanup alternative would reduce the potential for direct contact by limiting access to the contaminated area, but it would not eliminate it. The current threat to human health and the environment would remain.

5.3.2.3 Public Health Analysis for the Perimeter Fencing Alternative

The installation of a security fence around the contaminated soil and posting the site as a PCB-contaminated area would provide a slight health risk reduction. By limiting access to the site, there would be less possibility for direct contact or ingestion of the highly contaminated soils. The risk from the inhalation pathway would not be reduced at all by this alternative. The risk reduction would be short-term and only slight since the migration of the PCBs would continue beyond the fenced area and the contaminants would still be present at the site.

The greatest benefit of fencing and posting the area would be in making the potentially exposed population aware that the site is contaminated with PCBs. Thus, if access to the area would be required, the proper safety precautions could be taken. Overall, there would only be a slight short-term risk reduction and no reduction in the mobility, toxicity, and volume of contaminants at the site.

5.3.2.4 Institutional Analysis for the Perimeter Fencing Alternative

No permits would be required with the perimeter fencing alternative.

5.3.2.5 Cost Analysis for the Perimeter Fencing Alternative

5.3.2.5.1 Estimation of Costs. The cost of materials and installation of a 6-foot chain link fence topped with 3 strands of barbed wire and one walk-through gate to surround a 10 by 12.5-foot area was estimated at \$1,000 (Aspen Fence Co., Denver).

5.3.2.5.2 Present Worth Analysis. The fencing alternative would have direct capital costs, but no annual operating or maintenance costs. The installation of a fence could be completed in less than a week, and once installation was complete, there would be no further costs associated with this alternative. Thus, the present worth cost for this alternative would be \$1,000.

5.3.2.5.3 Sensitivity Analysis. The cost estimate for the fencing alternative is not sensitive to any assumptions or parameters at the site. There would be a minimal amount of material, labor, and time involved in the construction of a fence. The cost estimate provided above should be stable.

5.3.3 Detailed Analysis of the Excavation/KPEG Chemical Treatment/Backfilling/Incineration Alternative

5.3.3.1 Technical Analysis of the Excavation/KPEG Chemical Treatment/Backfilling/Incineration Alternative

5.3.3.1.1 Performance Appraisal. The intended function of the KPEG chemical treatment alternative would be the chemical treatment of the PCB-contaminated soils. The KPEG process has been proven effective in reducing PCB concentrations in soils from initial contaminant levels as high as 700 mg/kg down to levels less than 10 mg/kg. The treated soil is clean enough to be placed back into the excavated area without causing any harm to the environment or human health. The KPEG process is very effective in removing the PCBs from soil and reducing their toxicity.

5.3.3.1.2 Compliance with ARARs. The KPEG alternative would meet the ARAR that requires cleanup of the PCB-contaminated soil to less than 25 mg/kg. All the soil with PCB concentrations greater than or equal to 25 mg/kg would be excavated and treated. After treatment, the treated soil could be placed into the excavated area. The PCB concentrations would be reduced to less than 10 mg/kg, and the risk to human health and the environment would have been greatly reduced.

5.3.3.1.3 Site Waste Conditions. There would be some special site conditions that would complicate the excavation but should not affect the performance of the KPEG chemical treatment alternative. There is a concrete conduit and possibly some metal conduits running through the site and a concrete pad at the edge of the site. The conduits would have to be located prior to excavation. It is assumed that the soil beneath the edge of the concrete pad and below the conduits is contaminated. The excavation around

these structures would probably require shoring to support them until the excavated area was filled with clean fill. Another problem at the site is that the extent of contamination in the soil is not well defined. This would require semi-quantitative field testing of the soil to determine PCB levels, which would establish the boundaries of the excavation. These special site conditions would add to the time required for implementation but would not affect the performance of the chemical treatment alternative.

5.3.3.1.4 Operating Requirements. The KPEG process would require the use of specialized equipment. The pilot-scale KPEG process equipment used by Galson Remediation Corporation would be applicable for the quantity of soil requiring treatment at this site (Milicic, per. com., 1989). Experienced operators for this equipment would also be required to ensure efficient and effective operation of the system. The pilot-scale equipment has been proven effective in treating PCB-contaminated soils at other sites.

5.3.3.1.5 Storage and Transportation. A temporary storage area for the excavated soil would be required for storing the soil prior to treatment. The soil could be stored in barrels or on a lined and covered pad to prevent infiltration into soil or dust production. The time required for storage should be less than four weeks.

5.3.3.1.6 Alternative Results. The KPEG alternative would result in permanently treated soil. It would produce a liquid waste by-product which is normally disposed of through incineration. This alternative would minimize the PCB soil concentrations and destroy the contaminants removed from the soil. The greatly reduced soil concentrations of PCBs would minimize the potential for any future risks to human health and the environment.

5.3.3.1.7 Health and Safety Requirements. The implementation of the KPEG alternative would cause an increase in dust and require workers to handle the contaminated soil. Thus, workers would be required to wear protective clothing to prevent dermal contact and respirators to prevent inhalation. The treatment process would involve the use of various chemicals and the production of a liquid waste. Safety precautions for handling these chemicals along with safeguards for containing possible spills would also be required.

5.3.3.2 Environmental Analysis for the Excavation/KPEG Chemical Treatment/Backfilling/Incineration Alternative

The KPEG chemical treatment alternative should prevent any further damage to the environment and should provide protection to public health and welfare. The contaminated soil would be excavated and then treated using the KPEG process. The PCBs would be dechlorinated and separated from the soil. The residual from the KPEG process would be treated further for complete destruction.

This alternative would also address all pathways by removing the contaminants from the site. The treated soil could be placed into the excavated area and the problems of the site would be eliminated.

The beneficial effect of the KPEG alternative would be the complete and final solution to the PCB-contaminated soil problem at the site. This alternative also would have some adverse effects. The excavation of the soil would create dust and require workers to handle it, but with the use of proper safety equipment this problem could be eliminated. The KPEG process would require the use of chemical reagents which means there would be the potential for spills. These would require safe handling procedures to prevent harm to human health and the environment. The KPEG process would produce a liquid waste which would require transportation to a treatment facility for further treatment. This would require the use of proper containers and procedures for the transportation of hazardous waste.

The KPEG alternative would reduce the PCB levels at the site to levels less than 25 mg/kg. The original soil could be placed into the excavated area at its original contour. The low PCB concentrations remaining at the site will be at levels that present an acceptable risk to human health and the environment.

5.3.3.3 Public Health Analysis for the Excavation/KPEG Chemical Treatment/Backfilling/Incineration Alternative

This removal and treatment alternative would provide a high health risk reduction. All the soil with PCB concentrations at or above 25 mg/kg would be treated using the KPEG process, which means contaminant levels would be reduced to 1/28th of the known high value of 700 mg/kg. Under these conditions a 70 kg person would have to inhale/ingest 532 mg/day for the short-term exposure 10^{-6} cancer risk level and 0.64 mg/day for the long-term exposure 10^{-6} cancer risk level. This is a significant reduction in the risk to public health.

By removing and treating the contaminants, this alternative would provide reduction in mobility, toxicity, and volume. It could be implemented in a short time frame and its beneficial health effects could thus be recognized quickly. However, the chemical treatment alternative would not completely eliminate the risk at the site. PCB concentrations up to 25 mg/kg would remain at the site and a slight, acceptable risk would remain.

5.3.3.4 Institutional Analysis for the Excavation/KPEG Treatment/Backfilling/Incineration Alternative

Permitting for this remedial treatment would not be required under federal, state, regional, and local laws. However, licensing of the subcontractor performing the treatment, and subsequent transportation of the waste residue and of the incineration facility would be required. All DOT regulations would need to be followed for transportation of the waste including labeling, marking, placarding, use of proper containers, and reporting spills. The transporter would also be required to obtain an EPA Identification Number prior to transportation of the waste and to transport only waste which is accompanied by a manifest signed by the generator of the waste.

In addition to the above regulations, the city of Columbus, Ohio would require that the Fire Department be notified prior to transportation of the waste if the intended transportation route is within Columbus city limits.

5.3.3.5 Cost Analysis for the Excavation/KPEG Chemical Treatment/ Backfilling/Incineration Alternative

5.3.3.5.1 Estimation of Costs. The estimated cost for this alternative was based on approximately 60 cubic yards of contaminated soil and determined using a combination of references for the various actions of the alternative. The references are listed with the cost breakdown below:

Treatability Study	\$ 17,000 (Milicic, pers. com., 1989)
Excavation	2,500 (CECOS Inc., 3/89)
Field Sampling and Analysis	2,000 (Marsh, Ianniello, 1988)
Treatment and Process	
Waste Handling	180,000 (Milicic, pers. com., 1989)
Laboratory Analysis	2,000 (Brack, pers. com., 1989)
Backfilling	1,200 (HMTc, 1986)
TOTAL	<u>\$204,700</u>

The estimate for the field sampling and analysis was based on using the Kwik-Skrene Analytical Testing System for 35 samples. Laboratory analysis would be required to confirm the results of the field analysis and used to check the treated soil for PCB removal. The estimate for the laboratory analysis was based on a total of 20 samples.

5.3.3.5.2 Present Worth Analysis. The on-site chemical treatment alternative would have no annual operating or maintenance cost or any other future costs. The alternative could be implemented and completed in under a month, and once the treatment was completed, there would be no further actions required at the site. Because this alternative would be completed in a short time period, the present worth cost is the same as the above estimated cost of \$204,700.

5.3.3.5.3 Sensitivity Analysis. The key parameter affecting costs at this site would be the quantity of soil requiring removal and treatment. All cost estimates were based on an estimate of 60 cubic yards. The major cost of this alternative would be the mobilization, demobilization, set-up, take-down, and rental costs of the equipment required in the treatment process. This would make the cost of this alternative less sensitive to the quantity of soil

requiring treatment. The excavation and backfilling costs would decrease with a reduction in soil removal, but this will not significantly affect the cost. Overall, a 50% reduction in soil requiring treatment could lower the cost about 20 to 25%.

Another factor that could affect cost for this alternative would be the ability of the KPEG process to treat this site-specific soil. This would be determined in the treatability study and could add to the price of this alternative.

5.3.4 Detailed Analysis of the Excavation/Rotary Kiln Incineration/Backfilling Alternative

5.3.4.1 Technical Analysis of the Excavation/Rotary Kiln Incineration/Backfilling Alternative

5.3.4.1.1 Performance Appraisal. The intended function of the rotary kiln incineration alternative would be the removal and complete destruction of the PCB-contaminated soil. Incineration is a proven and reliable technology for destroying PCBs that can be implemented over a short period of time. Incineration is a very effective and permanent solution.

5.3.4.1.2 Compliance with ARARs. The rotary kiln incineration alternative would comply with the ARAR requiring the cleanup of PCB-contaminated soil to less than 25 mg/kg. All soil with PCB concentrations at or above 25 mg/kg would be excavated and transported to an approved incineration facility for destruction. The risk at the site would be greatly reduced and there would be no need for any further controls at the site.

5.3.4.1.3 Site/Waste Conditions. Again, as stated in 5.3.3.1.3, there would be some special site conditions that would complicate the excavation of the contaminated soil. These conditions would only add to the time required for excavation but would not affect the performance of the incineration alternative.

5.3.4.1.4 Operating Requirements. This alternative would have no special operation, maintenance, or monitoring requirements. The excavation of contaminated soils is a common practice and an off-site incinerator with experienced operators would be used.

5.3.4.1.5 Off-Site Facilities. The nearest incinerator that is approved to handle PCB-contaminated soils is the ENSCO incinerator in Eldorado, Arkansas. This is a rotary kiln incinerator that has had much experience with the incineration of PCBs. The incinerator will only accept containerized waste so the contaminated soils would have to be drummed. The incinerated soil or ash would be handled by ENSCO. They would stabilize the ash and then dispose of it in Chemical Waste Management's Emelle, Alabama landfill.

5.3.4.1.6 Storage and Transportation. The incineration alternative should not require any temporary storage for the excavated soil. The soil would be placed in Department of Transportation (DOT) approved drums and hauled by truck to the ENSCO incinerator in Eldorado, Arkansas.

5.3.4.1.7 Alternative Results. The rotary kiln incineration alternative would be a permanent solution that destroys the contaminants. It would significantly reduce any further threat to human health and the environment from the site.

5.3.4.1.8 Health and Safety Requirements. The implementation of the incineration alternative would create an increase in dust on site. Workers would need to handle the contaminated soil, requiring them to wear respirators and protective clothing to prevent dermal contact. The excavated soil would be transported in a way that meets all federal and local regulations for the transport of hazardous waste. The incineration facility would be informed of what the waste contains so they would be prepared to handle it.

5.3.4.2 Environmental Analysis for the Excavation/Rotary Kiln Incineration/Backfilling Alternative

The incineration alternative would prevent any further damage to the environment while protecting human health and welfare. All soil with PCB

concentrations at or above 25 mg/kg would be removed from the site and destroyed. Incineration is a proven technology for destroying PCBs in soils.

This alternative would address all pathways of concern by removing the contaminants. The contaminated soil would be excavated and removed from the site and replaced with clean fill to the original site contours. The problems at the site would be greatly reduced.

5.3.4.3 Public Health Analysis for the Excavation/Rotary Kiln Incineration/Backfilling Alternative

This removal and incinerator alternative would provide a high public health risk reduction. All contaminated soil with PCB concentrations at or above 25 mg/kg would be excavated and incinerated. This alternative would reduce the contaminant concentrations to 1/28th of the known high value of 700 mg/kg. Thus, the short-term and long-term exposure dosages for the 10^{-6} cancer risk level would increase 28 times from the no action dosages to 532 mg/day and 0.64 mg/day, respectively. This would mean a significant reduction in risk to public health.

By removing and destroying the contaminants by incineration, this alternative would provide a reduction in the mobility, toxicity, and volume of PCBs at the site. This alternative could be implemented in a short period of time; thus the risk reduction could be realized quickly. The incineration alternative would not eliminate all risk at the site. PCB concentrations up to 25 mg/kg would remain at the site, meaning a slight, acceptable risk would also remain.

5.3.4.4 Institutional Analysis for the Excavation/Rotary Kiln Incineration/Backfilling Alternative

Permitting for this remedial treatment would not be required under federal, state, regional, and local laws. However, licensing of the subcontractor performing the excavation and transportation of the waste and the incineration facility would be required. All DOT regulations would need to be

followed for transportation of the waste including labeling, marking, placarding, use of proper containers, and reporting spills. The transporter would also be required to obtain an EPA Identification Number prior to transportation of the waste and to transport only waste accompanied by a manifest signed by the generator of the waste.

In addition to the above regulations, the city of Columbus, Ohio would require that the Fire Department be notified prior to transportation of the waste if the intended transportation route is within Columbus city limits.

5.3.4.5 Cost Analysis for the Excavation/Rotary Kiln Incineration/Backfilling Alternative

5.3.4.5.1 Estimation of Costs. The estimated cost for this alternative was based on approximately 60 cubic yards of contaminated soil and determined using various references for each action of the alternative. The estimated cost breakdown and references used are listed below:

Excavation	\$ 2,500 (CECOS Inc., 1989)
Drums	9,000 (Denver Barrel and Drum, 1989)
Field Sampling and Analysis	2,000 (Marsh Ianniello, 1988)
Transportation	9,000 (CECOS Inc., 1989)
Incineration and Ash Handling	267,000 (Eckhart, pers. com., 1989)
Laboratory Analysis	1,500 (Brack, pers. com., 1989)
Backfilling	1,200 (HMTc, 1986)
TOTAL	\$292,200

The field sampling and analysis cost was based on the use of the Kwik-Skrene Analytical Testing System for 35 samples. Laboratory analysis would be required to confirm the field analysis.

5.3.4.5.2 Present Worth Analysis. The incineration alternative would have no annual operating or maintenance cost or any other future costs. This alternative could be implemented and completed within a week, and once completed, there would be no further actions required at the site. Thus, the present worth cost would be the same as the estimated cost of \$292,200.

5.3.4.5.3 Sensitivity Analysis. The key parameter that would affect costs at the PCB Spill Site would be the amount of soil to be incinerated. Therefore, if it was found that only 50 cubic yards of soil required incineration, the cost of this alternative would be cut to approximately \$244,000.

5.3.5 Detailed Analysis of the Excavation/Landfilling/Backfilling Alternative

5.3.5.1 Technical Analysis of the Excavation/Landfilling/Backfilling Alternative

5.3.5.1.1 Performance Appraisal. The intended function of the landfilling alternative would be to remove the PCB-contaminated soil from the site and dispose of it in a federally approved landfill. Landfilling is an effective and proven technology and the use of a federally approved landfill would reduce the risk of landfill failure.

5.3.5.1.2 Compliance with ARARs. The landfilling alternative would comply with the ARAR requiring the cleanup of the PCB-contaminated soil to concentrations less than 25 mg/kg. All soil with PCB concentrations of 25 mg/kg or greater would be excavated and landfilled. This would minimize migration and the risk to public health and the environment.

5.3.5.1.3 Site/Waste Conditions. Again, as stated in 5.3.3.1.3, there would be some special site conditions that would complicate the excavation of the contaminated soil. However, these conditions would only add to the time required to complete the excavation and would not affect the performance of the landfilling alternative.

5.3.5.1.4 Operating Requirements. Excavation of contaminated soil and the subsequent landfilling of the excavated material is a common practice. This alternative would require no special equipment, operation, maintenance, or monitoring.

5.3.5.1.5 Off-Site Facilities. The nearest landfill that accepts PCB-contaminated soils is Chemical Waste Management's Emelle, Alabama landfill. They meet all requirements and regulations for landfilling PCBs and have experience in handling PCB-contaminated wastes.

5.3.5.1.6 Storage and Transportation. This alternative would not require any temporary storage. The excavated soil would be placed directly into dump trailers, covered, and hauled to the Emelle, Alabama landfill.

5.3.5.1.7 Alternative Results. The landfilling alternative would minimize all risks at the site itself but there would be no reduction in the waste volume or toxicity. By placing the soils in a landfill, their contaminant mobility would be reduced and the potential for future releases to the environment would also be reduced.

5.3.5.1.8 Health and Safety Requirements. The implementation of the landfilling alternative would require similar safety requirements as the other alternative utilizing excavation. The excavation would cause an increase in dust and require workers to handle the contaminated soil. Thus, they would need to wear protective clothing to prevent dermal contact and respirators to prevent the inhalation of contaminated dust. The excavated soil would be transported to a federally approved landfill in a way that meets all federal and local regulations for the transport of hazardous waste. The landfill would be informed of the waste constituents in order to handle it properly.

5.3.5.2 Environmental Analysis for the Excavation/Landfilling/Backfilling Alternative

The landfilling alternative would prevent any further damage to the environment and provide protection for public health and welfare at the site. The PCB-contaminated soil would be excavated and transported to a landfill for disposal. There would still be the potential for the PCB-contaminated soil to cause damage to the environment and human health at the landfill, but it would be greatly decreased by reducing the mobility of the contaminants.

At the site, this alternative would address all contaminant pathways by removing the contaminant. Once excavation was complete, the problems at the site would be greatly reduced.

The beneficial effect of the landfilling alternative would be the complete and final solution to the problem at the site. This alternative also would have some adverse effects. The excavation and removal of the contaminated soil would create dust and would require the handling and transportation of hazardous waste. These problems could be mitigated by the use of proper safety equipment and handling methods along with the use of the appropriate containers for transportation. Another adverse effect of this alternative would be that landfilling the material would not reduce toxicity or volume of the contaminants but only reduces their mobility. There would always be the potential for landfill failure and damage to the environment and human health. By using an approved landfill, this potential for damage would be minimized.

The landfilling alternative would reduce the PCB levels at the site to levels less than 25 mg/kg. The problems at the site would be eliminated but there would still be a potential for harm to the environment and human health from the landfilled material.

5.3.5.3 Public Health Analysis for the Excavation/Landfilling/Backfilling Alternative

The landfilling alternative would provide a high public health risk reduction at the site. All soil with PCB concentrations at or above 25 mg/kg would be excavated and landfilled. This alternative would reduce the contaminant levels at the site to 1/28th of the known high concentration of 700 mg/kg, meaning that the short-term and long-term exposure dosages for the 10^{-6} cancer risk level will increase 28 times from those of the no action alternative. The short-term exposure dosage would increase from 19 mg/day for the no action alternative to 532 mg/day for the landfilling alternative. The long-term exposure dosage would increase from 0.023 mg/day to 0.644 mg/day. This would mean a significant risk reduction at the site. The public health

risk would be reduced to an acceptable level but would not be eliminated since concentrations of PCBs in the soil of up to 25 mg/kg would remain.

The excavation/landfilling/backfilling alternative would provide a significant risk reduction at the site. On the whole, however, this alternative only reduces mobility. The contaminated soils would be placed in a landfill where the toxicity and volume of contaminants would still be present. This means the risks that were present at the PCB Spill Site would now be present at the landfill. Overall, the public health risk would still be reduced, although not significantly, by reducing mobility and access to the PCB-contaminated soil.

5.3.5.4 Institutional Analysis for the Excavation/Landfilling/Backfilling Alternative

Permitting for this remedial treatment would not be required under federal, state, regional, and local laws. However, licensing of the subcontractor performing the excavation and transportation of the waste and of the landfill facility would be required. All DOT regulations would need to be followed for transportation of the waste including labeling, marking, placarding, use of proper containers, and reporting spills. The transporter would also be required to obtain an EPA Identification Number prior to transportation of the waste and to transport only waste accompanied by a manifest signed by the generator of the waste.

In addition to the above regulations, the city of Columbus, Ohio would require that the Fire Department be notified prior to transportation of the waste if the intended transportation route is within Columbus city limits.

5.3.5.5 Cost Analysis for the Excavation/Landfilling/Backfilling Alternative

5.3.5.5.1 Cost Estimation. The estimated cost for this alternative was based on approximately 60 cubic yards of contaminated soil and determined using various references for each stage of the alternative. The estimated cost breakdown and references used are listed below:

Excavation	\$ 2,500 (CECOS Inc., 1989)
Field Sampling and Analysis	2,000 (Marsh Ianniello, 1988)
Transportation	7,800 (CECOS Inc., 1989)
Disposal in Landfill	16,200 (CECOS Inc., 1989)
Laboratory Analysis	1,500 (Brack, pers. com., 1989)
Backfilling	1,200 (HMTc, 1986)
TOTAL	<u>\$31,200</u>

The field sampling analysis cost was based on the use of the Kwik-Skrene Analytical Testing System for 35 samples. Laboratory analysis would be required to confirm the results of the field analysis.

5.3.5.5.2 Present Worth Analysis. The landfilling alternative would have no future costs of any kind. This alternative could be implemented and completed within a week. Upon completion of the alternative, there would be no further action required at the site. Because of the short implementation time, the present worth cost is \$31,200, the same as the above estimated cost.

5.3.5.5.3 Sensitivity Analysis. The key parameter that would affect cost at this site would be the amount of soil requiring landfilling. All cost estimates were based on an estimate of 60 cubic yards of contaminated soil. The cost of this alternative would have almost a direct relationship to the amount of soil requiring landfilling. Therefore, if the amount of contaminated soil were found to be only 50 yards, the cost would be about 83% of the above estimated cost. If it were found that only 30 yards are contaminated, the cost would be about 50% of the above estimated cost.

5.3.6 Comparison of Alternatives

The five remaining alternatives will be compared using the results of the technical, environmental, public health, institutional, and economic analysis. This comparison of alternatives is presented in Table 5-5. The no action alternative is presented as a baseline against which the other alternatives can be compared.

TABLE 5-5
COMPARISON OF ALTERNATIVES

CRITERIA	NO ACTION ALTERNATIVE	PERIMETER FENCING ALTERNATIVE	EXCAVATION/KPEO CHEMICAL TREATMENT/ BACKFILLING/INCINERATION ALTERNATIVE	EXCAVATION/ROTARY KILN INCINERATION/ BACKFILLING ALTERNATIVE	EXCAVATION/LANDFILLING/BACKFILLING ALTERNATIVE
COST					
Capital Cost	\$0	\$1,000	\$204,700	\$292,100	\$31,200
Annual O&M Cost	\$0	\$0	\$0	\$0	\$0
Present Worth Cost	\$0	\$1,000	\$204,700	\$292,100	\$31,200
HEALTH INFORMATION					
Exposure Pathways Addressed	Does not address contamination in any way.	Slightly reduces risk from direct contact/ingestion by limiting access to the site.	Provides a significant reduction in risk from the direct contact/ingestion and inhalation exposure pathways.	Provides a significant reduction in risk from the direct contact/ingestion and inhalation exposure pathways.	Provides a significant reduction in risk at the site from the direct contact/ingestion and inhalation exposure pathways.
Short-Term Effects	Site conditions unchanged.	Alerts potentially exposed population to site problems.	Slight increase in dust and handling of contaminated soils during excavation and treatment. Thus, health risk is slightly increased for a short time.	Slight increase in dust and handling of contaminated soils during excavation and treatment. Thus, health risk is slightly increased for a short time.	Slight increase in dust and handling of contaminated soils during excavation, which will slightly increase health risks.
Time Until Protection is Achieved	Not Applicable	Fence installed in less than a week to reduce access to site.	The excavation and treatment could be completed in less than a month.	The excavation and treatment could be completed within a week.	The excavation and landfilling can be completed within a week.
Long-Term Effects	Area of contamination will slowly increase while concentrations will slowly decrease. All exposure pathways and risks remain.	Area of contamination will slowly increase while concentrations will slowly decrease. All exposure pathways and risks remain.	The contaminant levels are reduced to 1/20th of those under the no-action alternative, thus significantly reducing the health risk posed by the PCBs. Only a slight but acceptable risk remains at the site.	The contaminant levels are reduced to 1/20th of those under the no-action alternative, thus significantly reducing the health risk posed by the PCBs. Only a slight but acceptable risk remains at the site.	The contaminant levels are reduced to 1/20th of those currently at the site, thus significantly reducing the health risks at the site. Overall there is only a moderate risk reduction. There will be risks present at the landfill.
ENVIRONMENTAL EFFECTS					
Beneficial Effects	None	None	Removes PCBs from the environment and permanently destroys them.	Removes PCBs from the environment and permanently destroys them.	Removes PCBs from the site.
Adverse Effects	Contaminants will continue to slowly migrate and increase the volume of contaminated soil.	Contaminants will continue to slowly migrate and increase the volume of contaminated soil.	Excavation of PCB-contaminated soil may temporarily release PCBs into the atmosphere. There is the possibility of a spill from the on-site treatment process.	Excavation of PCB-contaminated soil may temporarily release PCBs into the atmosphere.	Excavation may temporarily release PCBs into the atmosphere. No reduction in toxicity or mobility. Risks are transferred to the landfill.
TECHNICAL ASPECTS					
Performance	NA	Effective in limiting access to the contaminated area. Effective in alerting the potentially exposed population to the PCB problem.	Effective in removing PCBs from site. Effective in destroying PCBs. Treatability study required.	Effective in removing PCBs from site. Effective in destroying PCBs.	Effective in removing PCBs from site. Effective in reducing mobility of PCBs.
ARAR Compliance					
- Chemical Specific	Does not meet the 40CFR761, PCB-spill cleanup policy requiring cleanup to 25 mg/kg.	Does not meet the 40CFR761, PCB-spill cleanup policy requiring cleanup to 25 mg/kg.	Will meet the 40CFR761, PCB-spill cleanup policy requiring cleanup to 25 mg/kg.	Will meet the 40CFR761, PCB-spill cleanup policy requiring cleanup to 25 mg/kg.	Will meet the 40CFR761, PCB-spill cleanup policy requiring cleanup to 25 mg/kg at the site.
- Location Specific	There are no location-specific ARARs.	There are no location-specific ARARs.	There are no location-specific ARARs.	There are no location-specific ARARs.	There are no location-specific ARARs.
- Action Specific	Would not meet any ARARs since there is no action.	There are no ARARs for constructing a fence.	Would meet requirements for excavation, treatment, and incineration.	Would meet requirements for excavation, incineration, and transportation of hazardous waste.	Would meet requirements for excavation and landfilling.
Special Site or Waste Conditions	None	None	Excavation will be complicated by presence of underground conduits running through the site.	Excavation will be complicated by presence of underground conduits running through the site.	Excavation will be complicated by presence of underground conduits running through the site.
Operation, Maintenance and Monitoring Requirements	None	None	The KPEO process will require the use of special equipment and trained operators.	No special operation, maintenance, or monitoring required.	No special operation, maintenance, or monitoring required.
Off-Site Facilities	None	None	The waste from the chemical treatment is incinerated. The waste is handled by the process contractors.	ENSCO rotary kiln incinerator, Eldorado, Arkansas	Chemical Waste Management Landfill, Emelle, Alabama
Result of Alternative	Current site conditions remain. The mobility, toxicity, and volume of contaminants remain unchanged. All risks remain.	The mobility, toxicity, and volume are unchanged. Access is limited to the site. All risks remain.	Soil with PCB concentrations at or above 25 mg/kg is removed and treated. The mobility, toxicity, and volume of contaminants are significantly reduced. A slight but acceptable risk remains at the site.	Soil with PCB concentrations at or above 25 mg/kg is removed and treated. The mobility, toxicity, and volume of contaminants are significantly reduced. A slight but acceptable risk remains at the site.	Soil with PCB concentrations at or above 25 mg/kg is removed from the site and landfilled. Only mobility of the contaminants is reduced by landfilling. A slight but acceptable risk will remain at the site. An added risk will be created at the landfill.
Safety Requirements	NA	Dust masks or respirators required by workers during fence installation.	Protective clothing and respirators will be required for workers to prevent direct contact with and inhalation of contaminants. Safe operating practices will be followed for the KPEO process.	Protective clothing and respirators will be required for workers to prevent direct contact with and inhalation of contaminants. All regulations for transporting hazardous waste will be followed.	Protective clothing and respirators will be required for workers to prevent direct contact with and inhalation of contaminants.
COMMUNITY EFFECTS					
Community Protection	Risk to community is not increased by alternative but all present risks to community still exist.	Risk to community is not increased by alternative. Present risk at site is only slightly reduced.	Risk to the community is slightly increased during the alternative implementation. Overall, risks are significantly reduced to an acceptable level.	Risk to the community is slightly increased during the alternative implementation. Overall, risks are significantly reduced to an acceptable level.	Risks to the community are slightly increased during the implementation of the alternative. Overall, the risks are significantly reduced at the site but will be increased at the landfill.

There would be no costs associated with the no action alternative, thus making it the least expensive alternative. The incineration alternative would be the most expensive alternative, with an estimated present worth cost of \$292,100, followed by the KPEG chemical treatment alternative at \$204,700. The landfilling alternative would be next at \$31,200 and finally, the fencing alternative at \$1,000.

The KPEG chemical treatment alternative, the incineration alternative, and the landfill alternative all would have the same health effects at the site. Overall, the chemical treatment and incineration alternatives would provide the most beneficial health effects. The fencing alternative and the no action alternative would provide little to no health benefits.

The environmental effects would be similar to the health analysis in that the most beneficial environmental effects would be provided by the chemical treatment and incineration alternatives with the chemical treatment providing the highest reduction in volume of contaminated soil. The landfill alternative would be the next best, followed by the fencing alternative and then the no action alternative.

In terms of technical aspects, all four of the action alternatives would be effective and are proven in producing their expected results. The KPEG process, however, is a relatively new process and has had limited experience with PCB cleanup. Although this limited experience has shown it to be very effective in treating PCB-contaminated soils, a treatability study would be required for this alternative to determine the potential effectiveness of the KPEG process at this site. Of these four, all but the fencing alternative would meet the cleanup requirements at the site. The chemical treatment, incineration, and landfilling alternatives all would have the same problem with excavation at the site due to the underground conduits. The chemical treatment alternative would require the mobilization and set-up of a treatment process on site. These three alternatives would all require the use of an off-site facility. The KPEG chemical treatment alternative and the incineration alternative would produce the most favorable results by completely destroying the PCBs.

The no action and fencing alternatives would create no additional risks at the site but they would not address the current risks at the site. These alternatives would probably not be accepted by an affected community. The chemical treatment, incineration, and landfilling alternatives all temporarily would increase risk to the community but, overall, they would provide significant long-term risk reduction at the site. The chemical treatment and incineration alternatives would completely destroy the PCBs and therefore would most likely be favored by the community. However, the relatively low costs associated with the landfilling alternative would make this alternative the most attractive.

6.0 RECOMMENDATIONS

This section presents the recommendations and the rationale for placing each of the six AF Plant 85 sites into one of the three categories developed by the Air Force for the IRP program. These categories are defined as follows:

1. **Category 1:** Sites and/or operable units where no further IRP action (including remedial action) is required. Existing data for these sites are considered sufficient to determine no significant impact on human health or the environment.
2. **Category 2:** Sites and/or operable units requiring additional IRP effort to 1) determine the MTV of detected contaminants, 2) evaluate human health and environmental risks associated with each contaminant, and 3) conduct the detailed evaluation of remedial alternatives.
3. **Category 3:** Sites and/or operable units where the Feasibility Study process has been completed (i.e., selection of remedial alternative).

Recommendations were developed based on information gathered during IRP Phase 1; Phase 2, Stage 1; and RI/FS, Stage 2 investigations of the six Plant 85 sites. The PCB Spill Site was the only site to be placed into Category 3 and will be discussed first. The Fire Department Training Area has been designated as a Category 2 site and will be discussed second. The remaining sites (Mason's Run, James Road Hazardous Waste Storage Area, Turkey Run, and the Perimeter Wells) have all been classified as Category 1.

6.1 RECOMMENDATIONS AND RATIONALE FOR CATEGORY 3 SITE: PCB SPILL SITE (SITE 3)

Site 3, ranked the number 1 concern in Section 4.2, is the location of a PCB spill which occurred at Substation 23, Transformer P-27, in January 1983. Transformer oil leaked onto the soil on the south side of the substation. Investigation of this site revealed PCB concentrations in the soil as high as 700 mg/kg. The complete extent of contamination is still unknown but it is estimated that approximately 60 cubic yards of soil are contaminated. This site was characterized as a Category 3 site and a feasibility study was conducted. The results of and recommendations based upon this study are discussed in the remainder of this subsection.

Phases I and II of the FS process produced five alternatives for the detailed analysis in Phase III. These alternatives include the No Action Alternative, the Perimeter Fencing Alternative, the Excavation/KPEG Chemical Treatment/Backfilling/Incineration Alternative, the Excavation/Rotary Kiln Incineration/Backfilling Alternative, and the Excavation/Landfilling/Backfilling Alternative. A summary of results from the detailed analysis and a comparison of these results can be seen in Table 5-5.

From the information obtained during the feasibility study, two possible alternatives emerged for the recommended action at Site 3: the Excavation/KPEG Chemical Treatment/Backfilling/Incineration Alternative, which represents the current legislative preference in SARA for treatment and destruction of contaminants, and the Excavation/Landfilling/Backfilling Alternative, which represents the more traditional alternative under CERCLA for the conditions at this site. Both of these alternatives would have similar beneficial on-site results.

The Excavation/KPEG Chemical Treatment/Backfilling/Incineration Alternative would involve the excavation of all soil with PCB concentrations at or above 25 mg/kg. The excavated soil would then be treated using the KPEG process, which has been proven effective in reducing PCB concentrations in soil to less than 10 mg/kg. The treated soil would then be replaced into the excavated area. Finally, the liquid waste from the treatment process would be incinerated.

The chemical treatment alternative would provide a significant reduction in risk at the site. The PCB concentrations would be reduced to 1/28th of the highest known concentration. The ARARs would be met by this alternative and the PCBs removed from the soil would be permanently destroyed.

This is a relatively new process but it has been proven effective in the field at this scale of operation. A treatability study would be required to determine reaction rates, PCB-removal efficiency, and reagent recovery. The operation of an on-site chemical process would introduce the possibility of a chemical spill and safety precautions would need to be taken to prevent and contain spills.

The Excavation/Landfilling/Backfilling Alternative would provide on-site results similar to the chemical treatment alternative, but at a much lower cost: \$31,200 as compared to \$204,700 for chemical treatment. The small quantity of soil requiring landfilling would also make this alternative attractive since landfilling would not reduce the volume of contaminants. The only drawback of this alternative would be that the PCBs would not be destroyed and thus there would be a risk present at the landfill from these contaminants. This risk could be minimized by utilizing an approved landfill which should eliminate access to the contaminants and minimize their mobility.

The No Action and Perimeter Fencing Alternatives were not considered for recommendation because of their limited impact on harmful site conditions. They would not meet ARARs nor provide any protection for human health or the environment, and they are not likely to be accepted by the community or the regulators.

The Excavation/Rotary Kiln Incineration/Backfilling Alternative would provide results very similar to the chemical treatment alternative. Although the chemical treatment alternative would provide a greater reduction in volume and would have a much smaller transportation risk than the incineration alternative, incineration would have some advantages. It is more proven, less experimental, and requires no treatability study or special training. However, the major difference between the two alternatives is the cost. The incineration alternative costs were estimated at \$292,000, while the chemical treatment alternative costs were estimated to be \$204,700. Based on the cost difference for similar favorable results, the KPEG chemical treatment alternative is recommended over the rotary kiln incineration alternative as the more cost-effective alternative that destroys contaminants.

The Excavation/KPEG Chemical Treatment/Backfilling/Incineration Alternative and the Excavation/Landfilling/Backfilling Alternative both would produce the desired results at the site. They would meet the ARARs, are technically implementable, and are proven effective at the scale of this IRP site. The advantage of the chemical treatment alternative is that it would destroy the majority of the PCBs. The advantage of the landfilling alternative is its low cost and simplicity.

Based on the above information, the Excavation/Landfilling/Backfilling Alternative is recommended as the remedial action for Site 3. Despite the fact that use of this alternative would not destroy the PCBs, it would reduce the PCB contamination at the site at considerably less cost. SAIC cannot justify recommending chemical treatment at this time, as it is not the most cost-effective alternative. Perhaps if the costs of this chemical treatment alternative have been reduced by the time the remediation plan is being developed, this alternative could be reconsidered.

6.2 RECOMMENDATIONS RATIONALE FOR CATEGORY 2 SITE: FIRE DEPARTMENT TRAINING AREA (SITE 4)

As a part of Combined Site 4/8, the Fire Department Training Area was ranked number 2 in Section 4.2. Although a variety of organic compounds were detected in soil and groundwater samples collected from Site 4, none of the concentrations exceeded any regulatory standards.

TCE and a variety of other solvents were found in soil samples in relatively low concentrations, none exceeding established standards or guidelines. The one exception to this is the 189 mg/kg concentration of TCE found in soil sample S0403 at a depth between 7.5 and 9.0 feet. Although confirmed in second-column analysis, this Stage 1 value may be suspect due to the low concentration found in its duplicate (1.3 mg/kg, unconfirmed). However, assuming that this high value was valid, the health risk from this compound was examined. TCE has a high water solubility, yet it was not detected in the groundwater samples collected from the downgradient well monitoring the area of the borehole in which it was found. This is probably due to the very low permeability of the soils in this area. Although TCE is highly volatile, the depth at which this compound was detected indicates that the only risk to health from TCE would occur during excavation at this site.

An argument for no further action could be made for this site unless the property were to be sold. Because of the depth at which the high TCE value was detected, excavation of this soil for a building foundation could volatilize the TCE, allowing it to enter the atmospheric pathway. If no further

action were to be taken to investigate the TCE, the Air Force would likely be required to include a deed disclosure, describing the possibility of TCE on the site, in any agreement they might make to sell the property. To avoid the possibility of future liability at this site, the Air Force would benefit from determining further if the TCE is actually present at this site and to what extent.

Recommendations for a Stage 3 investigation include another soil-gas survey, drilling an additional borehole, and collecting more soil samples to identify any soil volume with high TCE values. To avoid duplicating the problems encountered during Stage 1, a Stage 3 soil-gas survey would need to be conducted using more sensitive instrumentation and during a drier season, such as late summer or early fall. The number of boreholes to be drilled and samples to be taken would depend on the results of the soil-gas survey. The area of investigation should be focused in the fire training pit around the collection station for soil sample S0403.

6.3 RECOMMENDATIONS RATIONALE FOR CATEGORY 1 SITES

The following discussions provide the rationale for recommending placement of the remaining sites into Category 1. A Technical Document Supporting No Further Action (TDSNFA) will be developed for each of three sites; the perimeter wells should not require a TDSNFA as they are not associated with an actual site of waste disposal.

6.3.1 Mason's Run (Site 5)

Mason's Run was ranked number 2 in Section 4.2. The presence of high concentrations of PAHs, oil and grease, and metals in the sediments in the vicinity of the oil/water separator system and concrete weir indicate that a very small, localized health risk does exist. These contaminants are associated with this system and should be cleaned up as part of the regular maintenance program for the system. The small amount of contaminated sediment, particularly upstream from the concrete weir, should be barreled and properly disposed of as petroleum hydrocarbon products. Because this situation is seen as a maintenance problem, it was determined that the expense of preparing a

full-scale Feasibility Study was not warranted. Therefore, a TDSNFA has been prepared on Site 5.

6.3.2 James Road Hazardous Waste Storage Pad (Site 8)

As a part of Combined Site 4/8, the James Road Hazardous Waste Storage Pad was ranked number 2 in Section 4.2. Although a variety of organic compounds were detected in soil and groundwater samples collected from Site 8, none of the concentrations exceeded any regulatory standards.

There does not appear to be a threat to human health or the environment from the presence of PAHs in the one soil sample collected from what is thought to be an old roadbed at JRHWP. These contaminants are of limited areal extent and total PAH concentration did not exceed the tentative Netherlands guidelines which would warrant further investigation of these compounds in soils. Also, they were not detected in groundwater samples collected from monitoring wells at Combined Site 4/8. Since these contaminants are not very soluble in water, and they are highly adsorbent to soil, the likelihood of them entering the groundwater is very low, especially considering the low yield of the water-bearing formation. Finally, the depth at which the PAHs were found is such that the only risk to health would occur if they were excavated. However, even if excavated, there is inadequate evidence that the PAHs found at this site would be carcinogenic in humans or would damage the environment.

Freon 113 was the only contaminant of concern detected in the groundwater; and, it was not detected in any of the soil samples. Although the concentration did exceed the action level established by the state of California, it was detected in a transitional water-bearing zone. This zone is not used as a water supply, nor is it expected to be, due to its low yield. In addition, this compound is noncarcinogenic with an acceptable oral route intake in chronic situations of 3.0 mg/kg/day, which would allow an average person to ingest 2,100 mg/day.

Based on the above information, the James Road Hazardous Waste Storage Pad was placed in Category 1 and a TDSNFA was prepared for it.

6.3.3 Turkey Run (Site 10)

Site 10 was ranked number 4 in Section 4.2. Despite the high metals concentrations in sediments collected from Turkey Run, it was determined that this site did not pose an apparent threat to human health and the environment. The rationale for this decision is as follows:

1. The metals are apparently bound up in the sediments since concentrations of the same constituents in the surface water are low and do not exceed any primary MCLs, even the more stringent, proposed ones.
2. Although surface waters are the primary source of municipal water supplies in Franklin County, no known supplies are present within 3 miles downstream of the Plant. Although a present threat to human health is not of concern via this pathway, the future use of the larger downstream creeks as a water supply is unknown.
3. Access to the facility is restricted, which eliminates incidental dermal contact with and ingestion of these metals by children and inhalation is highly improbable; therefore, these exposure pathways are not present.
4. According to the Ohio Division of Natural Areas and Preserves, the only endangered or threatened species or critical habitats within 5 miles of the facility are located upstream, to the northeast of Plant 85; therefore, there is no risk to these environmentally sensitive areas from Plant activities around Turkey Run. Further, Turkey Run flows through a very industrialized setting and a healthy natural stream environment could not be achieved unless more than the Plant's 375-foot segment of this low-flowing stream were involved in cleanup activities.
5. With the possible exception of zinc, there is no significant increase in the concentrations of the metals (used for comparison with guidelines) due to Plant activities. Barium and copper increased in concentrations only slightly.
6. No specific federal or state regulatory standards exist for metals in sediments and the criteria used for comparisons are guidelines only.

Based on the above information, Site 10 was placed in Category 1 and a TDSNFA was prepared for it.

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